



# **PROBLEMS**

IN

## **Elementary Mathematics**

ADAPTED TO

**THE S. S. L. C. SYLLABUS**



BY

**P. S. GANESA SASTRI, M.A , L.T.,**  
ASSISTANT, NATIONAL COLLEGE, TRICHINOPOLY



WITH

**A FOREWORD**

BY

**Prof. R SRINIVASAN Ayl., M.A., M.R.A.S.**  
MAHARAJA'S COLLEGE, TRIVANDRUM



PRINTED AT

**THE MADRAS LAW JOURNAL PRESS, MYLAPORE**

---

1929

**Price Re. 1-2-0.]**

**[Ninth Edition.**



## FOREWORD.

TEACHERS who are in touch with the Mathematics work in the S. S. L. C. classes have felt that the text books generally used in the schools do not always give examples of the type of the S. S. L. C. Examination questions. A perusal of the question papers of the last three or four years will show that there is ample justification for this feeling on the part of the teachers. This book of examples is intended to supply that need. I have gone through the examples and have no hesitation in saying that they are well arranged and chosen with a view to give as many varieties of problems under a given heading as possible. I am sure this work will be a great help to the teachers as well as the pupils of the Secondary schools.

Though it is true that the principles to be applied in Arithmetic are only a few in number, there is almost no limit to the variety of problems to which they can be applied. The author has taken care to get as many problems as possible from various sources. We find here problems from *Lilavati* and *Ganitasarasangraha* and also from the S. S. L. C. examination papers themselves. I should think that this book will be received with great avidity by all interested in Secondary School Mathematics teaching.

Trivandrum,  
11th June, 1920

R. SRINIVASAN.

# CONTENTS.

Ex. No.	Subject.	Page.
I	Problems leading to Simple Equations	
II.	Percentages	7
III	Averages	11
IV	Simple Interest	13
Va.	Simultaneous Equations	15
b.	Problems involving Simultaneous Equations	16
VI	Square Root	22
VII	Compound Interest	26
VIII	<i>a</i> Circle <i>b</i> . Plane Circular Ring <i>c</i> . Sectors	31
IX.	Cubic Measure	35
X.	Symbolical Expression Part I	39
XI.	Significant Figures and Contracted Methods	43
XII	<i>a</i> Chords <i>b</i> . Segments	46
XIII.	Right Prisms	48
XIV	Right Circular Cylinders	48
XV.	Pyramid	54
XVI	Right Circular Cone	55
XVII	Partnership	57
XVIII	Profit and Loss	59
XIX.	Time and Work	62
XX.	Symbolical Expression Part II	65
XXI	Graphs	67
XXII	Practical Geometry Triangle Quadrilateral Parallelo- gram Rhombus Trapezium Theorem of Pytho- goras Square Root Circum-circle Tangents In- scribed Circle Regular Polygons Similar triangles Paper Folding	74
XXIII.	Ratio	92
XXIV.	Miscellaneous Examples	93
	S.S.L.C. Examination Papers 1913—29	97
	Collection of Formulæ	132
	General Instructions	133
	Answers	138

# PROBLEMS

## IN

### ELEMENTARY MATHEMATICS.

---

#### EXERCISE I

#### Problems leading to Simple Equations.

1. Out of a heap of pure lotus flowers, a third part, a fourth, and a fifth part were offered to Siva, Vishnu and the Sun, respectively, and a sixth part was presented to Saraswati and the remaining nine lotuses were presented to the venerable guru, find the whole number of flowers.

2. The suppery pole used in the Krishnajayanti festival has 12 of its length under the earth and 75 of the remainder covered with sticky substances. If the remaining portion measures 11 feet, find the length of the pole.

3. Rama was twice as rich as Krishna. Krishna gave away one-sixteenth of his property and Rama one twenty-fourth of his to a college, which together amounted to Rs. 1,750. How much was each worth?

4. A man travelled a certain distance at 5 miles an hour and thrice the same distance at 4 miles an hour. If he takes on the whole 9 hrs. 30 min. find the total distance travelled.

5. A boy would have saved 5 minutes if he had gone to school at 6 miles per hour instead of at 5 miles per hour. How far is his house from the school?

6. The circumference of the forewheel of a carriage is 12 ft. and that of the hindwheel is 16 ft. If one makes 1320 revolutions more than the other in travelling a certain distance, find the distance travelled.

7. A contractor engaged for his business a certain number of men, twice the number of women, and thrice the same number of boys. The daily wages of a man, a woman and a boy were 14 as., 8 as., and 4 as. respectively. If the total daily wages amounted to Rs. 52—8—0, find the number of men, women and boys.

8. A hotel-manager bought a certain number of wall-lamps, half the number of hurricane lamps and a third of the same number

of shades at 12 as., Rs 2—14 as., and Rs 4 each respectively. If Rs 42—4 as were spent on the whole, find the number of wall-lamps bought.

9 A fruit seller bought a certain number of apples at Rs 3 a dozen, thrice the same number of oranges at 5 for 3 as. and 10 times the same number of mangoes at Rs. 9—6 as. per hundred. If the total cost was Rs. 19—8 as, find how many of each sort he bought.

10. A man travelled a certain distance by coach, five times the distance by motor and 20 times the same distance by rail. The fares for a mile of travelling by coach, motor, and rail are 3 as, 2 as, and 6 ps., respectively. If the total cost of the journey was Rs. 17—4—0, find the distance travelled by rail.

11. A carriage, a horse, and the harness cost Rs. 900, the price of the horse is thrice that of the harness and the price of the carriage double that of the horse and harness. What was given for each?

12. A timber merchant sold 20 chairs, 64 benches and 12 tables for Rs. 1,460. If a bench costs half as much again as a chair, and a table costs Rs. 15 more than a chair, find the cost of a chair, a table and a bench.

13. Divide Rs. 272 among A, B and C so that B may get Rs 12 more than A, and C Rs. 8 more than B

14 The strength of two schools A and B is in the ratio of 3 : 4. The average monthly fees paid by a pupil in A and B are Rs 4 and Rs. 3—8 as respectively. If the school B gets Rs 440 more than the other every month, find the strength of the two schools.

15. A man spent Rs. 1,192 in buying cows at Rs 25 each and sheep at Rs 8 each. If he bought 64 heads in all, find the number of cows bought.

16. In a magic performance 320 tickets were sold for Rs 28—12 as. If a first class ticket costs 2 as. and a second class 1 anna, find the number of first class tickets.

17. On a certain railway the second and the third class fares are 7 ps. and 3 ps. respectively per mile. A man who travels 100 miles and possesses Rs. 2—6—6 spends it in going part of the distance second class and the remainder third class. How far does he travel in the second class?

18. An oil merchant has two sorts of oil, ground-nut oil worth 14 as. 6 ps. a viss and pure gingelly oil worth Re. 4—4—0 a viss. If

he makes a mixture of 55 viss worth Re. 1—3—0 a viss, how many viss of each kind does he take?

19. A purse worth Rs. 23—12—0 contains a certain number of rupee coins, twice the number of anna pieces and four times the number of quarter anna pieces. Find the number of coins of each kind.

20. A sum of Rs. 17—8 as. is made up of 4 anna and 2 anna pieces. If there are 100 coins on the whole, find the number of two anna pieces.

21. A bag is worth Rs. 9—2—0 and contains on the whole 56 coins of 4 anna, 2 anna and 1 anna pieces. If the number of anna pieces is half as much again as the number of 2 anna pieces, find the number of coins of each sort.

22. The capacity of 8 bottles and 5 jars is 324 cub. in. If each jar contains 5 cub. in. more than a bottle, find the capacity of a bottle.

23. 6 cubes of copper and 5 similar cubes of iron weigh 806 grams. If a cube of iron weighs 17 grams less than a cube of copper, find the weights of a cube of copper and of iron.

24. A purse contains 4 anna coins and 2 anna coins which are together worth Rs. 15. If the number of coins of the latter sort is 12 more than that of the former, find the number of coins of each kind.

25. A person bought a certain number of fruits, one half of them at 2 an anna and the other half at 3 an anna. He sold them at the rate of 5 for 2 as. and lost an anna by the transaction. Find the number of fruits.

26. A market woman bought a certain number of geese at 3 s. 3 d. each and two-thirds of that number at 4 s. 3 d. each, she sold the lot at 8 s. a pair and gained £ 3-10 s. by the transaction. How many of each kind did she buy?

27. A merchant mixes 23 quarts of wine worth 5 s. a quart with another wine worth 3 s. a quart so that the mixture is worth 3 s. 6 d. a quart. How many quarts of the second kind does he mix?

28. A merchant mixed a certain quantity of inferior sugar worth 10 as. a viss with 15 viss of superior sugar worth Re. 1 a viss. If a viss of the mixture is worth 14 as. 6 ps, find the quantity of inferior sugar.

29. A rice merchant mixed 12 bags of superior rice worth Rs. 18 per bag with a certain number of bags of inferior sort worth Rs. 15 a bag. He sold the whole at Rs. 19—8 as. a bag and gained

Rs. 54 by the transaction. Find the quantity of rice of the inferior sort in the mixture

**30** A milkman bought a certain quantity of milk at 3 as. 9 ps. a measure and added 7 measures of water. If by selling the mixture at 4 as 6 ps a measure he gained 50% on the outlay, find the quantity of milk bought

**31.** A man bought some tea at 1 s 8 d. per lb. and mixed it with twice as much tea of another sort worth 1 s. 6 d. per lb. One-sixth of the total mixture was destroyed and the remainder was sold at 1 s. 11 d. per lb. If the profit amounted to 3 s, find the quantity of tea bought.

**32.** There are two numbers one of which exceeds the other by 12. Three times the less exceeds twice the greater by 36. Find the numbers.

**33.** Twice a certain number increased by 4 is divided by 6. If the quotient is less than the number itself by 6, find the number.

**34.** Thrice a certain number diminished by 7 is divided by 2. If the quotient exceeds the number by 3, find the number.

**35** Divide 48 into two parts such that the quotients obtained by dividing the two parts by 6 and 2 may be equal.

**36.** There are two numbers whose difference is 36. The quotient obtained by dividing the greater by 12 exceeds by 2 that obtained by dividing the less by 8. Find them.

**37.** Divide Rs. 160 between A and B so that one-third of A's money exceeds three-eighths of B's by Rs 8

**38.** A gentleman spent Rs. 600 in charity and gave half of the remaining sum to his son, one-third of the remainder to his daughter and the rest to his wife. If he gave Rs. 1,500 more to his son than to his daughter, find the sum he originally had.

**39.** Rama and Krishna had equal sums of money at the beginning of a certain year. The former doubled his property and spent Rs. 500, while the latter trebled his property and spent Rs. 1,750. If two-fifths of Rama's property at the end of the year exceeded one-fourth of Krishna's by Rs. 500, find how much they had at first.

**40** From a certain sum of money I took away a third part and put in its stead Rs. 50. From the sum thus increased I took away a fourth part and put in its stead Rs. 70. I then found I had Rs. 120 left. What was the original sum?

**41.** A train starts with a certain number of passengers. At the first station two-fifths of the passengers get down and 144 get in.

At the second half the new number get down and 174 get in. If there are 450 passengers in the train after leaving the second station, find the number of passengers with which the train started.

**42** I have Rs 35 more in my left hand pocket than in my right. If I take Rs 10 from the left pocket and put them into my right, I will have in my left a fifth as much again as in the right. Find the sum of money I have in each pocket.

**43** A sum of Rs. 1,100 was divided between A and B so that if B had received Rs. 120 more, he would have had Rs 50 less than A. How much did each get?

**44** A room is one fourth as long again as it is broad. If the length and the breadth be both increased by 6 ft., the room will be a fifth as long again as it will be broad. Find the dimensions of the room.

**45** The length of a black-board exceeds its breadth by 2 ft. If both be increased by 1 foot, its area will be increased by 11 sq. ft. Find the length of the board.

**46.** If a room were 5 ft wider, it would have been a square. If the length and the breadth be both decreased by 3 ft and 2 ft respectively, the area would be diminished by 129 sq. ft. Find the length of the room.

**47.** A room is one-fifth as long again as it is broad. If the breadth be increased by 2 ft., and the length be decreased by 2 ft., the area would be increased by 4 sq. ft. Find the length of the room.

**48** The gross income of a person was £ 40 more in the second of two particular years than in the first. But the income-tax rose from 4 d. in the pound in the first year to 6 d. in the pound in the second year. If his net income was the same in the two years, find his income in the two years.

**49.** How many bundles of hay at Rs. 5 per hundred must a person mix with 5,600 bundles at Rs. 6 per hundred in order that he may gain 20 per cent. by selling the whole at 11 as. per ten bundles.

**50.** I bought a horse and a carriage for Rs 800 and sold the horse at a gain of 12% and the carriage at a loss of 4% and gained on the whole  $3\frac{1}{2}\%$ . Find the prime cost of the carriage.

**51.** The simple interest on Rs 500 for  $2\frac{1}{2}$  years at a certain rate per cent. and that on Rs 350 for  $3\frac{1}{2}$  years at 2% less per annum amount to Rs.173—8—0. Find the rates.

**52.** A and B shared between them a sum of Rs. 540 in the ratio of 4 : 5. The interest on A's sum for a certain number of years at 4% per annum S. I. and that on B's sum for a year more at  $2\frac{1}{2}\%$  per annum S. I. are together equal to Rs 93. Find the periods for which the interest is paid.

**53.** A sum of rupees 550 is lent partly at 4% and partly at 2% per annum. If the total annual interest is Rs 17, how much is lent at 2%?

**54.** Two sums of money lent at 5% per annum S. I. amount to Rs. 462 in 2 years. If the difference between the two sums is Rs. 20, find them.

**55.** I invest Rs 360 partly at 3% and partly at 5% per annum obtaining the same income as if I had invested the whole at  $3\frac{1}{4}\%$ . How much do I invest at each rate?

**56.** A man borrows a certain sum of money at 7% per annum S. I. He keeps it for 2 months and then lends it at 18% per annum S. I. At the end of 2 years (after he borrows it) he finds that he has gained Rs 228. Find the sum borrowed.

**57.** I wished to give a certain number of old men 6 as 3 ps each and I found that my purse contained Rs 2—4—3 less. I gave them 5 as. each and then I found that the purse contained Rs. 2—3—0 more. Find the number of old men.

**58.** A labourer was engaged for 25 days on condition that for every day he worked he would be paid 14 as. and for every day he was absent he should pay the master a fine of 4 as. a day. At the completion of the period he was paid Rs 19—10—0. Find the number of days he was absent.

**59.** A labourer was engaged for a number of days on condition that he would be paid Re 1—2—0 for every day he worked and he should pay a fine of 4 as. for every day he was absent during the period. He was absent for 5 days. At the end of the period he received Rs. 43—12—0. Find the number of days he worked.

**60.** A cook who is hired for Rs 180 and some clothes a year works for 5 months and receives Rs. 63—5—4 and the clothes. Find the value of the clothes.

**61.** A shepherd bought 5 cows of one sort at Rs. 55 each and a number of cows of another sort at Rs. 35 each, and kept them for one month, the average maintenance charges being Rs. 13 per cow per mensem. He then sold all of them at an average price of

Rs 68—1—0 each and thus gained  $12\frac{1}{2}$  per cent. on his outlay. Find how many cows of the second sort he bought.

62. A person bought a picture at a certain price and paid the same price for the frame, if the frame had cost Re. 1 less and the picture 12 as. more, the price of the frame would have been only half that of the picture. Find the cost of the picture.

63. The gross income of a person was Rs. 4 more in the second of 2 particular years than in the first, but as he paid income-tax at the rate of 4 pies in the rupee in the first year and at the rate of 5 pies in the rupee in the second year, his net income in the second year was Rs. 6—8—0 less than his net income in the first. What was his gross income in each year?

64. A merchant bought a certain quantity of superior sugar at Re. 1—4—0 per viss. Had the price been 20 per cent. cheaper, he would have bought 8 viss. more for the same amount. Find the quantity of sugar he bought.

65. The trunk road from A to B is 4 miles longer than the foot-path running from A to B. A man can travel along the former at 4 miles an hour and along the latter at 3 miles an hour. If he can save 20 minutes by walking along the foot-path, find the lengths of the road and of the foot-path.

66. A man can walk from A to B and back in a certain time at the rate of 4 miles an hour. If he walks at  $3\frac{1}{2}$  miles an hour from A to B and at  $4\frac{1}{2}$  miles an hour from B to A, he will take  $6\frac{2}{3}$  minutes longer. Find the distance from A to B.

67. A person who can walk up-hill at  $2\frac{1}{2}$  miles an hour, and down-hill at  $3\frac{1}{2}$  miles an hour ascends and returns to his starting point in 4 hours and 48 minutes. How far has he walked?

68. Rama and Govind start from P to Q a distance of  $31\frac{1}{2}$  miles at 6 and  $4\frac{1}{2}$  miles an hour respectively. Rama reaches Q, returns immediately and meets Govind at R. Find the distance from P to R.

---

## EXERCISE II.

### Percentages.

1. In the time table of a class 8 hours are given to English, 3 hours to Tamil, and 5 hours to Mathematics. If the total number of school hours is  $27\frac{1}{2}$ , what percentage of the total time is left for the other subjects?

2. In a certain town having 33,048 voters, the two candidates for selection secured 15,530 and 10,408 votes. What percentage of the voters did not vote ?

3. 12% of the inhabitants of a town in India died of plague. The actual number of deaths was 1,836. What was the original population ?

4. In a school of four sections the first contained 18%, the second 22% and the third 28% of the total number of scholars. If the fourth contained 64 scholars, find how many there were in the first, the second and the third sections respectively.

5. In a mixed school of three departments the number in the boys' department is 35.25% and that in the girls' department is 23.75% of the whole. If there are 46 more boys than girls, find the number in the infants' department.

6. In a school of 1,200, the number presented for an examination was 20% of the whole, while the numbers passing in the first and second classes were respectively  $12\frac{1}{2}\%$  and  $32\frac{1}{2}\%$  of those presented. Find the number presented and the number passing in each class.

7. The cost of maintaining a certain school for one year was Rs. 48,250. If fees amounted to Rs. 36,745 and the Government grant to Rs. 7,200, find what percentage of the expenditure was met by (1) the fees and (2) the grant.

8. A certain kind of ore contains 75% of iron. If 2% of the iron is wasted in the process of extraction, what weight of ore would produce 7 tons 7 cwt of iron ?

9. A garden is 80 feet long and 42 feet broad. A bed 3 feet wide is constructed all round on the inside and a path 4 feet wide inside it. The rest is a lawn. What percentage of the whole area of the garden are the bed, the path and the lawn ?

10. 6% of those who applied for an examination absented themselves and 65% of those who sat for the examination failed. If 3,619 candidates came out successful, find the number of candidates who applied for the examination.

11. 70% of the area of a farm is arable. Of the remainder 80% is pasture and the rest is waste. If the area of the waste is  $1\frac{1}{2}$  acres, find the area of the farm.

12. The population of a town has increased  $3\frac{1}{2}\%$  in a given interval. But if it had been 2,450 less than it is, there would have been a decrease of  $3\frac{1}{2}\%$ . Find the original population.

13. The population of two wards of a town were equal and after the former had fallen 4% and the latter risen 6%, the total population of the two wards was 37,370. What was the population of each ward at first?

14. The population of two towns are 1,07,509 and 1,89,160. Their birth rates per thousand are 27.9 and 25.7. Find, to the same degree of exactness, the birth rate for the two towns taken together.

15. The population of two towns are 3,69,630 and 6,87,720 and their death rates are 17.1 and 15.5 per thousand respectively. Find, to the same degree of exactness, the death rates for the two towns taken together.

16. A boy obtained 28% of the total marks in an examination and failed for want of 34 marks, while another secured 52% of the marks and got 14 marks above the minimum. Find the total number of marks and the minimum required.

17. The salary of a clerk is increased by  $14\frac{2}{3}\%$  on account of a famine. He is then given a war allowance of 20% over his increased pay. He is then given a grain allowance of  $8\frac{1}{4}\%$  over his new salary. If he now gets Rs. 26, find his original salary.

18. A merchant went to three fairs in succession. In the first he increased his capital by 10%. In the second he increased his then capital by  $11\frac{1}{3}\%$  and in the third he increased his then capital by  $12\frac{1}{2}\%$ . If he returned with Rs. 900 more, find the sum he took with him.

19. The receipts of a company amounted in one year to Rs. 1,77,000 and the expenses to Rs. 1,25,000. In the subsequent year the receipts fell off by 2% and the expenses increased by 1%. Find by what percentage of itself the profit in the first year exceeded the profit in the succeeding year.

20. "The whole revenue of the United Kingdom in the year 1901-2 was £143,581,542 and the revenue from income-tax was £. 35,378,700. If the revenue from income-tax is 25% less for the year 1903-4 and that from other sources 10% more, what will be the revenue for the year to the nearest pound? What percentage, correct to two decimal places, of the whole revenue is then furnished by the income-tax?"

21. The gross profit of a company is Rs. 16,000. Its working expenses are 35% of the gross profit and 10% of the net profit is transferred to the reserve fund. Find the capital of the company, if the share-holders receive a dividend of 8%.

**22.** The capital of a company is Rs 1,20,000. Its working expenses are 40% of its gross receipts and 10% of its net profit is put to a reserve fund. What must be the yearly gross receipts of the company to pay the shareholders a dividend of 6%?

**23.** In an examination 80% of the candidates are boys and the remainder girls; 35% of the boys and 40% of the girls are successful. If 256 candidates fail, find the total number of candidates who sit for the examination

**24.** The number of candidates that sat for an examination in the several centres A, B, C & D were 164, 61, 110 and 213 respectively and the numbers that passed in each were 83, 30, 37 and 71. Find the percentage of passes at the most, and at the least, successful centre.

**25.** A man lost 5% of his property in a certain year, 10% of the remainder in the next year, and 15% of the then remainder in the third year. What percentage of his original property remained at the end of the third year?

**26.** A cloth loses 5% of its length and 5% of its breadth by shrinkage. What per cent of its original area does it lose?

**27.** An alloy contains by weight 85% of copper, 12% of tin, and 3% of zinc. Find the cost to the nearest £ of  $2\frac{1}{2}$  tons of the alloy when copper costs £ 52—10 s per ton, tin £ 125 per ton and zinc £ 25 per ton.

**28.** A bucket contains 12 measures of milk of which 85% is pure milk, another bucket contains 16 measures of which 62.5% is pure. If both are mixed, find the percentage of pure milk in the mixture

**29.** A measure of milk contains 10% of water. If an ollock of water is added, how much per cent of pure milk is there in the mixture?

**30.** A jar of gingelly oil contains 30 viss of which 10% is ground-nut oil. How much of pure gingelly oil should be added so that the mixture may contain only 7.5% of ground-nut oil?

**31.** 35% of the people in a district live in towns. If the population of the district has increased by 12% and of those living in towns by 20%, what percentage of the total population now live in villages and what is the increase per cent. of people in villages?

**32.** A, B and C are three Arts Colleges of a locality, which contained in a certain year 55%, 35% and 10% of the total college-going population. In the next year the strength of the three colleges

increased by 4%, 6% and 12%, respectively. What percentage of the total college-going population was there in each of the three colleges? By how much per cent. did the total college-going population increase?

### EXERCISE III

#### Averages.

1. The average mark of 35 boys of a section is 72 and that of 38 boys of another section is 36. Find the average for the two sections.

2. The average age of a football eleven is 19 years and that of five of them is 18 years. Find the average age of the remaining six.

3. The average weight of the boys of a school of 820 is 72 lbs. and by the admission of 16 new boys the average weight is raised to 73 lbs. Find the average weight of the new boys.

4. The average weight of a regiment of 640 soldiers that went on a campaign is 142 lbs. If the average weight of the 500 that returned is 144 lbs., find the average weight of those that died.

5. The population of four villages numbering 480, 550, 650 and 800 ten years ago have since decreased by 5, 8, 12 and 16 per cent. respectively. Find (1) the present average population of the four villages and (2) the average decrease per cent.

6. An army of 3,000 consists of Hindus and Muhammadans. The average weight of a Hindu is 148 lbs., that of a Muhammadan 154 lbs. and that of the army is  $151\frac{1}{2}$  lbs. Find the number of Hindus in the regiment.

7. An army of 12,000 consists of black men and white men. The average height of a black man is 5 ft. 11 in., that of a white man is 5 ft. 10 in. and that of the army is 5 ft.  $10\frac{1}{4}$  in. Find the number of white men in the army.

8. A merchant bought goods worth Rs. 1,200. He sold a fourth of them at a gain of 8%, one third at a loss of 2% and the remainder at a gain of 10%. What percentage profit did he receive on the whole?

9. Out of a sum of Rs. 1,800, Rs. 400 are lent at 8%, Rs. 600 at 9% and Rs. 350 at 10%. At what rate per cent. should the remaining sum be lent so as to get  $9\frac{1}{2}\%$  on the whole?

10. A school with 78 boys and 72 girls on the rolls met 360 times in a year. If each boy loses 1 meeting in 9 and each girl 1 in 8, find the average attendance of each sex for a meeting.

11. The average maximum shade temperature from the 1st to the 7th of April both days inclusive was  $100^{\circ} 2'$ . The temperature on the 1st was  $99^{\circ} 9'$  and the average from the 2nd to the 8th was  $100^{\circ} 6'$ . Find the temperature on the 8th.

12. The average sale receipts of a company from the 4th to the 12th April both days inclusive amount to Rs 350. The value of the sale on the 4th is Rs 180, and that on the 13th is Rs 360. Find the average sale receipts from the 5th to the 13th both days inclusive.

13. The average weight of the 8 oarsmen in a boat is increased by  $2\frac{1}{2}$  lbs. when one of the crew who weighs 11 stones 12 lbs is replaced by a new man. What is the weight of the new man?

14. The annual average depth of rainfall for the three years 1879, 1880 and 1881 at a certain place was 24.98 inches and for the succeeding three years it was 29.62 inches. The year 1883 was the rainiest, when there fell 4.8 inches more than in 1882, 6.36 inches more than in 1884, and 7.47 inches more than in 1880. The year 1881 was short of the preceding year by only 17 inch. Find the depth of rain that fell in each of the six years.

15. The full pension granted to an officer retiring from Government service is half his average salary for the last 3 years of his service, but in the case of an officer who enters service after the age of 30, the full pension is reduced by one-fortieth for every year by which his age at admission into service exceeds 30. Express the pension of such an officer in terms of a full pension and of his age at admission into service.

Determine what pension a man who enters service at the age of 35 receives upon retiring, if his salary per mensem during the last 3 years of his service is Rs 375 for 10 months, Rs 350 for 3 months, Rs 370 for 8 months, Rs 380 for 9 months and Rs 400 for 6 months.

16. The average age of 16 members of a Free Boarding House on March 1, 1921 was 15 years 3 months, of them 4 read in the Sixth Form, their average age on that date being 17 years 6 months. Find the average age of the members of the house on July 1, 1921 if all the Sixth Form students leave the house and 3 boys whose average age on July 1, 1921 is 14 years 4 months join the same.

17. An officer drew the following salaries during the last three years of his service. If his monthly pension is half of the average monthly salary for the last three years, find the amount of his pension.

From 1—8—1924 to 31—5—1925	Rs. 240 per month
„ 1—6—1925 „ 15—9—1925	Rs. 260 „
„ 16—9—1925 „ 30—4—1926	Rs 360 „
„ 1—5—1926 „ 20—11—1926	Rs. 420 „
„ 21—11—1926 „ 31—7—1927	Rs. 480 „

(both days inclusive).

## EXERCISE IV.

### Simple Interest

1. A mirasdar worth Rs. 75,000 has wet lands worth Rs. 36,000 and dry lands worth Rs. 23,000, the rest being cash invested in a bank. The wet lands yield an income of  $5\frac{1}{4}\%$  and the dry lands  $4\frac{5}{8}\%$  per annum. If he gets  $5\frac{5}{8}\%$  on the whole, find the rate of interest paid by the bank.

2. A man borrowed Rs. 1,100 at  $8\%$  per annum S. I. and lent it as follows Rs. 450 to A at  $12\%$ , Rs. 375 to B at  $14\%$  and the remainder to C at  $10\%$  per annum S. I. At the end of  $1\frac{1}{2}$  years he collected all the moneys due to him from A, B and C and cleared his debt. Find his gain.

3. In a Savings Bank interest is paid at  $7\%$  per annum S. I. for fixed deposits of two years and more, and at  $6\%$  for fixed deposits of one year and more. Rama invested a certain sum for 2 years and Govind invested double that sum for  $1\frac{1}{2}$  years. At the end of the periods they withdrew the sums due to them. If Rama received Rs. 1,710, find how much Govind got from the bank.

4. A landlord bought for Rs. 40,000 a store containing 25 houses of one type, 14 houses of another type and 10 houses of a third type, the monthly rent for a house of the three types being Rs. 8, Rs. 5 and Rs. 3 respectively. The Municipal tax per half-year amounted to Rs. 240 and the annual repairs to Rs. 200. If a bill collector was paid Rs. 10 per mensem, find the rate of interest got by the owner (All the houses were occupied during the year.)

5. Rama borrowed Rs. 275 from A at  $8\%$  per annum S. I., Rs. 325 from B at  $10\%$  per annum S. I. and Rs. 625 from C. At the end of 2 years he sold  $1\frac{1}{2}$  acres of land at Rs. 1,113 per acre and cleared the debts. Find the rate of interest charged by C.

6. A man bought vessels worth Rs. 72 from a merchant. He paid Rs. 12 at once and Rs. 63 at the end of 4 months. What rate of interest did the merchant get for his money?

7. I borrowed Rs. 100 from a Chettiar at 12% per annum S. I. promising to pay it at the end of 10 months. He deducted the interest for the period and gave me the balance. If I paid Rs. 100 at the end of the period, find the rate of interest got by the Chettiar.

8. A borrowed from B Rs. 325 at 8% per annum S. I. and after keeping Rs. 25 for his own use he lent the remaining sum to C. After 2 years and 6 months A collected the amount due from C and with it cleared his debt. Find the rate of interest paid by C.

9. For the marriage of his daughter a man borrowed Rs. 1,200 at 10% per annum S. I. and 4 months after, another sum of Rs. 250 at 12% per annum S. I. for Deepavali expenses. After a certain time he sold 1 acre and 69 cents at Rs. 1,000 per acre and cleared the two debts. How long did the loans continue?

10. In a printing press a month's time from the date of the bill is allowed for paying the bill, after which interest is claimed at 12% per annum. In part payment of a bill for Rs. 520, I paid Rs. 70 at once and Rs. 490—8—0 after a certain period. How many months after the date of the bill was the account cleared?

11. A jewel worth Rs. 525 is pledged for Rs. 375 with a sowcar who charges 16% per annum S. I. How long can the sowcar wait for the repayment of the loan if he does not want to lose his money?

12. A money lender borrowed from a marwari at 10% per annum S. I. Rs. 740 in the shape of 7 hundred rupee notes and 4 ten rupee notes. On the way by mistake he gave a hundred rupee note in return for Rs. 10 cash. He at once lent the sum on hand to a clerk at 16% per annum. When the amount due from the clerk was equal to that due to the marwari, the two transactions were closed. Find the period of the loan.

13. When will the interest on a sum invested at  $6\frac{1}{4}\%$  per annum S. I. be three-eighths of the principal?

14. Three brothers, Siva, Rama and Krishna had equal shares in a house. Rama took the whole house, and 16 months after the partition paid Rs. 864 to Siva and 3 months later Rs. 876 to Krishna in settlement of their accounts. How much did they value the house at the time of the partition?

15. A question being proposed in an examination, to find the simple interest on a certain sum of money for  $8\frac{1}{2}$  months at  $6\frac{1}{4}\%$  per annum, a candidate by mistake calculated interest for  $8\frac{1}{2}$  months at  $6\frac{1}{2}\%$  per annum and obtained a result too high by 4 s. 2 d. Find the correct result.

**16.** A person borrowed on 1—7—1922 Rs 2,400 at 9% per annum S I. and executed a promissory note for the sum The following entries appear on the pro-note

Date	Particulars.	Sum paid.
1—10—1923	Paid for the interest due up to date and towards the principal	Rs. 1,070.
1—4—1925	"	. " 616.
1—12—1926	"	.. " 580.

How much should the person pay on 1—7—1927 to clear the account? [Note —Out of the sum paid at any time the interest due up to date should first be deducted and the balance should be adjusted towards the principal]

**17** On the 1st of April every year the Post Office Savings Bank pays interest at 3% per annum on the smallest sum of whole rupees that remains between the 4th day and the last day of every month, in the account of a depositor A person deposited on 1—4—1927 Rs. 320 and the following transactions took place between 1—4—1927 and 31—3—1928 July 1st deposited Rs. 40, Aug. 10th withdrawn Rs. 60, Aug 24th deposited Rs. 20-4 as, Sep. 3rd withdrawn Rs. 80, Nov 18th withdrawn Rs. 70, Nov. 29th deposited Rs. 49—12—0, Jan 20th, 1928 withdrawn Rs. 120, Feb. 2nd deposited Rs. 105 Find the interest added to his account on 1—4—1928

### EXERCISE V a.

#### Simultaneous Equations

Solve—

1.  $x + y = 9$

$x - y = 4\frac{1}{2}$

3.  $6x - 14y = 4$

$11y - 3x = 2$

5.  $77x - 44y = 451$

$39x + 26y + 13 = 0$

7.  $123x - 347y = 145$

$347x - 123y = 1265$

9.  $7(2x - y) + 5(3y - 4x) + 30 = 0$

$y - 7x = 15$

10.  $2x - \frac{y-3}{5} = 4$

$3y + \frac{x-2}{3} = 9$

2.  $x + 2y = 2$

$x - 3y = 12$

4.  $3x - 7y = 1$

$5x - 12y - 1 = 0$

6.  $5x + 7y = 29$

$7x + 5y = 31$

8.  $3x - 4y = 22 - 2y$

$5x + 2y = 42$

11.  $3(x + y - 5) = 2(y - x)$   
 $3(x - y - 7) + 2(x + y - 2) = 0$

$$12. \quad 3x + 5y + 3 = 5x - 7y + 8 = 8x - 2y + 4$$

$$13. \quad 3x + 8 = 4y - 4 = 2(x + y - 1)$$

$$14. \quad \frac{3x}{4} + \frac{y}{3} = 8$$

$$\frac{x}{4} - \frac{2y}{3} + 2 = 0$$

$$16. \quad 3x - \frac{y+7}{11} + 2 = 10$$

$$2y + \frac{x+11}{7} - 10 = 0$$

$$18. \quad \frac{5x}{6} - \frac{7y}{8} + 4 = 0$$

$$\frac{x}{6} + \frac{y}{8} = 4$$

$$20. \quad \frac{1}{x} + \frac{2}{y} = 8$$

$$\frac{4}{x} - \frac{2}{y} = 2$$

$$22. \quad \frac{2}{x-1} + \frac{4}{y+3} = 2$$

$$\frac{3}{x-1} + \frac{10}{y+3} = 4$$

$$24. \quad \frac{3}{x+4} + \frac{5}{y+5} = 8$$

$$\frac{9}{x+4} + \frac{5}{y+5} = 3$$

$$15. \quad \frac{x}{2} + \frac{y}{5} = 4$$

$$\frac{x}{5} + y + 3 = 0$$

$$17. \quad \frac{x+2}{7} + \frac{y-x}{4} = 2x-8$$

$$\frac{2y-3x}{3} + 2y = 3x+4$$

$$19. \quad \frac{2}{x} + \frac{3}{y} = 13 \text{ Put } \left(\frac{1}{x} = l, \frac{1}{y} = m\right)$$

$$\frac{1}{x} - \frac{2}{y} + 4 = 0$$

$$21. \quad \frac{3}{x} - \frac{1}{y} = 1$$

$$\frac{2}{5x} + \frac{5}{2y} = 7$$

$$23. \quad \frac{3}{x+y} + \frac{10}{x-y} = 2$$

$$\frac{2}{x+y} - \frac{3}{x-y} = \frac{1}{8}$$

$$25. \quad \frac{4}{x+2} + \frac{5}{y+2} = 2$$

$$\frac{5}{x+2} + \frac{4}{y+2} = 2 \frac{1}{20}$$

## EXERCISE V b

### Problems involving Simultaneous Equations

1 A shepherd bought 3 cows and 5 buffaloes for Rs. 460 and another bought 5 cows and 7 buffaloes for Rs. 680 at the same rate. Find the price of each animal

2. Rama bought one morning 3 seers of sweetmeats and 11 seers of coffee for Rs. 3-13-9 and in the same evening 2 seers of sweetmeats and 9 seers of coffee for Rs. 2-11-3 Find the cost of a seer of sweetmeats

3 Four measures of ghee and 3 viss of gingelly oil cost Rs. 18-12-0 and 3 measures of ghee and 4 viss of gingelly oil cost Rs. 16-4-0. Find the cost of a measure of ghee and a viss of oil

4 Rama bought 2 viss of sugar and 5 viss of coffee seeds for Rs. 12-12-0 and Krishna bought  $1\frac{1}{2}$  viss of sugar and 4 viss of coffee

seeds for Rs 10-2-0 at the same rate. How much will Govind have to pay for a viss of sugar and a viss of coffee seeds?

5. A man pays a rent of Rs 244 for two pieces of land at the rate of Rs 10 per acre for the one and at Rs 12 per acre for the other. If the rates are interchanged, the rent will amount to Rs. 240. Find the number of acres in each.

6. A farm consists of arable land let at 20 s. per acre and pasture let at 30 s per acre, the total rent being £ 350, when the rent of the arable land is reduced by 5 s per acre, and that of the pasture by 8 s per acre, the total rent is reduced by £ 90. Find the number of acres in the farm.

7. A farm consists of Nunja lands and Punja lands. When the rent per acre of the former is Rs 10 and that of the latter is Rs 2, the total rent amounts to Rs 920. If the rent per acre of the Nunja land is reduced to Rs 8 and that for the Punja is raised to Rs. 3, the total rent will amount to Rs 820. Find the number of acres in each.

8. 15 men and 12 boys earn Rs. 47-4-0 in 3 days, while 25 men and 18 boys earn Rs. 51 in 2 days. Find the daily earnings of a man and a boy.

9. The charge for first class tickets of admission to an exhibition, was Rs. 3 and that for the second class Rs 1-8-0, the whole number of tickets sold was 450 and the total amount collected Rs 810. Find the number of first class tickets.

10. A bag contains Rs 51 in 4 anna coins and 2 anna coins. If the numbers of 4 anna and 2 anna coins are interchanged, the bag will contain Rs. 40—8. Find the number of coins of each sort.

11. A sum of Rs 81-4-0 is made up of 2 anna and 1 anna pieces. The number of 2 anna pieces exceeds twice the number of 1 anna pieces by 25. How many coins are there of each kind?

12. In a school the sum of the areas of a hall and 2 class-rooms is 3072 sq ft, while that of the same hall and 5 similar rooms is 4080 sq. ft. Find the area of the hall.

13. The contents of a 18 gallon cask would just fill either 90 bottles and  $1\frac{1}{2}$  jars or 72 bottles and 3 jars. Find the separate capacities of a bottle and a jar.

14. A mason requires 12 stones of one size and 16 of another if he has to pave 160 sq. ft. of space, if he has to pave 735 sq. ft. he requires 40 stones of the first sort and 90 of the second. Find the size of each stone.

**15.** A person has two horses and a saddle. If the saddle be put on the first horse, his value becomes double that of the second but if the saddle be put on the second horse, his value will be less than that of the first horse by Rs 350. Find the value of the horses, if the saddle is worth Rs 75.

**16.** A number of sovereigns and shillings are together worth £ 82-10 s. and together weigh 22,275 grains. How many are there of each? A sovereign weighs 123 grains, a shilling weighs 87 grains.

**17.** A rides from T to L on the bicycle in 3 hrs 45 mins and B goes by train in 1 hr. 48 mins. If the average rate of the train be 12 miles an hour quicker than that of the bicycle, but the length of the journey by train be 6 miles greater than that by bicycle, find both rates and distances.

**18.** I wished to give a certain number of old men 1 a. 8 ps. each and I found that I had not money enough in my purse by 11 as. and so I gave 1 a. 5 ps. each and then I had 3 as. 3 ps. to spare. Find the number of old men and the sum I had.

**19.** A person has a certain amount of money to divide among a certain number of people. If he gives Rs. 2 each, he will have Rs. 20 left over. But there are 10 people too many for him to give Rs. 2—8 each. Find the amount he has to give away and the number of people.

**20.** My brother earns three-fourths of what I earn per mensem. Every year I spend Rs. 200 more than he. At the end of 2 years he has saved Rs. 280 while I, Rs. 600. Find our monthly income.

**21.** Rama and Krishna buy books worth Rs. 96. Rama gives all his money and Krishna three-fourths of his. If Rama had given three-fourths of his money and Krishna all of his, they would have bought books worth only Rs. 93. How much money did each have?

**22.** A and B go out shopping. A spends Rs. 2—12 and B Rs. 2—8. It is then found that A has  $2\frac{1}{2}$  times as much as B. A then lends B Rs. 1—4, and B spends Rs. 3—8, after which A has 20 times as much as B. Find the money each had at first.

**23.** There are two numbers whose sum is 66. Four-fifths of one number exceeds four-ninths of the other by 8. Find the numbers.

**24.** A number consists of two digits whose sum is 11. If the digits are reversed, it is increased by 9. Find the number.

**25.** A number consists of two digits whose sum is 9. If 45 is added to it, the digits are reversed. Find the number.

**26.** When a number of two digits is divided by their sum, the quotient is 4. When 27 is added to the number, the digits are reversed. Find the number

**27.** Vadivelu was asked his age and that of his sister and he replied, "If I were 2 years older, I should be twice as old as my sister, but if she were 2 years older, she would be three-fourths as old as I am." Find their ages

**28** Son — "Mamma, what is my age now ?" Mother — "Darling, 4 years ago I was  $3\frac{1}{2}$  times as old as you were and 8 years hence you will be half as old as I will be. Tell me your age."

**29** Mani — "Sister, kindly give me one out of the fruits given to you by our father so that I may have thrice as many as you may then have." Sita — "Brother, excuse me, if you kindly give me one from what you have, we may then have an equal number." Find the number of fruits that each had

**30.** If the length of a school room is increased by 2 ft. and the breadth diminished by 2 ft., the area is diminished by 24 sq. ft. If the length is decreased by 3 ft. and the breadth increased by 4 ft., the area is increased by 43 sq. ft. Find the dimensions of the room

**31** The area of a room is increased by 2 sq. ft. both when the length is decreased by 3 ft. and the breadth increased by 2 ft. and when the length is increased by 2 ft. and the breadth decreased by 1 ft. Find the dimensions of the room.

**32** If a certain room were half as wide again as it is, it would be a square. If it were 4 ft. longer and 1 ft. wider, its area would be 136 sq. ft. greater than it is. Find its dimensions

**33.** A horse and a carriage cost Rs. 600. If the horse had cost 10% less and the carriage 25% more, they would have been purchased for Rs. 73 more than the original sum. Find the price of each.

**34** Ravi and Gopal together earn Rs. 250 per mensem. If the former gets 5% less and the latter  $7\frac{1}{2}\%$  more, they will get the very same amount. Find the earnings of each

**35.** The population of a town is 40,000. If the number of males were increased by 6% and the number of females decreased by 4%, the population would become 40,030. Find the number of males and females in the town

**36.** An income of Rs. 160 is derived from money invested partly at  $3\frac{1}{2}\%$  and partly at 3% per annum. If the investments were interchanged, the income would be Rs. 165. How much is invested at each rate?

**37** A man borrows two equal sums of money at 5% and 4% per annum S. I. He finds that he will have to pay Rs. 1,100 in each case if the loan at 4% is repaid 6 months after the other loan is cleared Find the sum borrowed and the period for which interest is paid.

**38** When the price of sugar rises 50% and the price of coffee 10%, the increase in the price of 2 lbs of coffee and 8 lbs. of sugar which together originally cost 9 s + d is 2 s What were the original prices of sugar and coffee ?

**39.** The salaries of 7 graduate teachers and 5 under-graduate teachers of a school amount to Rs. 705. If the former are given an increment of 5% on their salary and the latter 10% on their salary, the management will have to pay Rs. 43—6—0 more Find the average salary of a graduate teacher and of an under-graduate teacher.

**40.** A man has to walk a certain distance He finds that, if he walks  $\frac{1}{4}$  of a mile an hour faster, he will take 20 minutes less, but if he walks  $\frac{1}{2}$  a mile an hour slower, he will take 52 minutes more. Find the distance and his rate of walking

**41** A broker travels a certain distance and finds that, if he had gone one mile an hour faster, he would have saved  $1\frac{1}{2}$  hours, but if he had gone  $\frac{1}{2}$  a mile an hour slower, he would have taken one hour longer Find the distance and the rate of his travelling

**42** Ravi cycled from P to Q If he had increased his speed by 2 miles an hour, he would have arrived at Q 42 minutes earlier. If he had decreased it by 1 mile an hour, he would have been late by 30 minutes Find his rate of cycling and the distance from P to Q.

**43.** A certain number of boys agree to bear an equal share of the cost of an entertainment. Had there been 4 more to pay the same bill, the share of each would have been 8 as. less and had there been 3 less, the share of each would have been 8 as more Find the number of boys and the share of each.

**44** A sum of money was divided equally among a certain number of men, had there been 6 more, each would have received 8 annas less, and had there been 4 fewer, each would have received 8 annas more than he did, find the sum of money and the number of men.

**45** The speed ( $s$ ) of sound in air in feet per second at a temperature  $t^\circ$  (Fahrenheit) is given by the expression  $s = a + bt$  When  $t = 32$ ,  $s = 1087$  and when  $t = 41$ ,  $s = 1096$ , find the value of  $s$  when  $t = 70$ .

**46.** A man sold his house and lands for Rs 15,700 gaining 6% on the house and 4% on the lands. Had he sold them so as to gain 4% on the house and 6% on the lands, he would have realised Rs. 100 more. How much did the house and the lands cost him?

**47.** A man sold a carriage and a horse for a profit of 8% and 12% respectively and thereby gained Rs 102. If he had sold the two at a uniform profit of 10%, he would have gained Rs 3 more. Find the price of each.

**48.** Two passengers have together 5 cwt. of luggage and are charged 6 s. 4 d. and 9 s. 8 d. respectively. If the whole luggage had belonged to one of them, he would have been charged 19 s. 8 d. Find the weight of luggage allowed free and the rate at which the excess is charged.

**49.** Passengers are allowed a certain amount of luggage free in a train. Two passengers paid 8 s. 9 d. each for excess luggage for the same journey. If one of them travels alone and takes with him the luggage of both, he has to pay 19 s. 6 d. for excess luggage. If the combined luggage weighs 1204 lbs, how much is allowed free?

**50.** The charge for luggage for a given journey is  $a(1-b)$  where  $x$  maunds is the weight and  $a$  and  $b$  are constants,  $b$  maunds being the weight allowed free of charge. If 30 maunds of luggage are charged Rs. 7-6-0 and 75 maunds of luggage Rs. 18-10-0, how much can be carried free and what is the charge for each extra maund?

**51.** Rama and Govind are 32 miles apart. If they walk in opposite directions, they meet in 4 hours, but if they walk in the same direction, Rama will overtake Govind in 16 hours. Find their rates.

**52.** A man takes 3 hours to bike 15 miles and walk 6 miles, he will take 15 minutes less to bike 10 miles and walk 7 miles. Find his rate of walking.

**53.** A boat goes in 10 hours 30 miles up-stream and 44 miles down-stream. It also goes up-stream 40 miles and down-stream 55 miles in 13 hours. Find the rate of the stream and of the boat.

**54.** A man takes 6 hours to travel 20 miles down-stream and 16 miles up-stream. If he takes the same time to travel 15 miles down-stream and 18 miles up-stream, find the rate of flow of the stream and of the boat.

**55.** A train 88 yards long passes a person walking in the opposite direction in 6 seconds. If he were travelling in the same direction, it would have passed him in  $8\frac{2}{11}$  seconds. Find the rate of the man and that of the train.

**56.** A train 132 feet long passes a man travelling in the opposite direction in 3 seconds. If he were travelling in the same direction, it would have passed him in  $3\frac{3}{4}$  seconds. Find the rate of the man and that of the train.

**57.** Two trains 88 yards and 77 yards long pass each other in  $11\frac{1}{4}$  seconds when they travel in opposite directions. If they were travelling in the same direction, they would have passed each other in  $56\frac{1}{4}$  seconds. Find the rates of the two trains.

### EXERCISE VI

#### Square Root

**1.** Find the square root of  $-a$  3969,  $b$  9025,  $c$  11881,  $d$ . 1771361,  $e$ . 2985984,  $f$ . 1522756,  $g$ . 1371739369

**2.** Find the square root of  $-53$  1441, 1.2544, 262144, '002401, 8210'1721, 18308'7961, 170 3025 931 165225.

**3.** Find, correct to three places of decimals the sq. root of  $-167$ , 13, 3, '5, '072,  $\frac{8}{15}$ ,  $\frac{7}{8}$ ,  $1\frac{2}{3}$ ,  $7\frac{3}{8}$ , 1'234, '073, 18'001

**4.** To how many places of decimals does  $\frac{248}{11}$  approximate to the sq. root of 35?

**5.** Find, correct to four places of decimals, the error involved in taking the average of  $\sqrt{5}$  and  $\sqrt{6}$  for  $\sqrt{5.5}$ .

**6.** If  $78^2 = 6,084$ , find the squares of  $-79$ , 781, 77 & 777

**7.** The distance  $s$  in feet travelled in  $t$  seconds by a body falling from rest is given by the relation  $s = \frac{1}{2}gt^2$  where  $g = 32.2$ . Find  $t$  when  $s = 3242$ .

**8.** The time  $t$  in seconds of the oscillation of a pendulum  $l$  ft. long is given by the formula  $t = 2\pi\sqrt{\frac{l}{32.2}}$ . Find  $t$  when  $l = 8.48$  ft

**9.** Find the sq. root of 2025 and hence write down the sq. roots of 20 25, 2025 and 202500. Can you write down the sq. root of 2 025?

**10.** If the S. I. on a sum of money is  $\frac{1}{16}$  of the principal and the number of years is equal to the rate% per annum, find the rate%.

**11.** In a regiment there are as many men in each row as there are rows in the regiment. If there are 1024 men in the regiment, find the number of men in each row.

**12.** The expenses of a picnic party amounted to Rs 95—1—0. If each member subscribed as many annas as there were members, find the amount subscribed by each.

**13** In a garden containing 48672 trees the number of rows is double the number of trees in each row. Find the number of trees in each row.

**14** How many times should a man run round a square field of 10 acres to cover a distance of  $1\frac{1}{2}$  miles?

**15** When the rent per acre is Rs. 8, the total rent of a square farm amounts to Rs. 320. Find the cost of fencing the farm at 2 as 8 ps. a foot.

**16** Find the length of a side of a square whose area is equal to the sum of the areas of two squares whose sides are 10.5 inches and 36 inches respectively.

**17** ABC is a triangle right angled at B. If  $AB = 7$  cm. and  $BC = 24$  cm, find the length of AC.

**18** Find the length of a diagonal of a rectangle whose adjacent sides are 9.6 cm. and 18 cm.

**19.** Find the length of a diagonal of a square of side 15 in.

**20.** A square field contains 1 sq. mile. Find, in miles, correct to three decimal places, the distance from one corner to the opposite corner?

**21** A field of 8 acres is represented on a map by an area of  $1\frac{1}{4}$  sq. inches. Find the scale of the map (i.e.) how many inches go to the mile.

**22.** A square field is bordered by a path 3 ft. wide, the field and the path together occupying 1 acre 2904 sq. yds. Find the cost of making the path at 4 as. a sq. yd.

**23.** The length of a floor is to its breadth as 7 : 6. The cost of covering it with carpet 4 ft. wide at 9 s. 9 d. per yd. is £ 18-19-2. What is its length?

**24.** A rope connects the top of a pole 12 ft high with a peg on the ground 20 ft. from its foot. Find the length of the rope.

**25** Two vertical poles 17 ft and 25 ft. high are 15 ft. apart. Find the distance between their tops.

**26.** To what height will a ladder 25 ft. long reach when placed against a wall, its foot being 7 ft from that of the wall? What would be the distance of the foot of the ladder from the wall, if it reaches to a height of 20 ft. from the ground?

**27.** A ladder 50 ft. long reaches to a window 48 ft. from the ground on one side of a street. It is turned with its foot fixed when it reaches to a height of 40 ft. from the ground on the other side of the

street Find the width of the street and the distance between the windows Verify your result by drawing a figure

**28** A ladder  $12\frac{1}{2}$  ft long leans against a wall and reaches to a point 10 ft from the ground The ladder slips and its foot is 4 ft farther from the wall Find the length by which the top of the ladder has come down (1) by drawing to scale and (2) by calculation

**29.** A ladder  $12\frac{1}{2}$  ft. long stands upright against a wall How far must the foot of the ladder be drawn out so as to lower the top half a foot ?

**30** A tree  $24\frac{1}{2}$  ft. high breaks in a storm and the top of the tree touches the ground at a distance of  $3\frac{1}{2}$  ft. from its foot Find the height of the point at which the tree has broken

**31.** "A lotus-bud is 6 inches visible above the surface of water Being driven by the wind it disappears under water at a place  $2\frac{1}{2}$  feet from its original position. Supposing the lotus-stem to move straight find the depth of the water" [Lilavati]

**32** "A peacock sitting at the top of a tree 60 ft. high sees a serpent emerging from a hole 120 ft. from its foot and proceeding to a hole at the foot of the tree. The peacock flies down in the air obliquely and catches the serpent when both have travelled the same distance. Find the distance, from the foot of the tree, of the point where the serpent was caught." [Lilavati].

**33** A person sitting at a distance of 160 ft from the foot of a tree 120 ft high shoots a bird sitting at its top Find the time that elapses before the bullet hits the bird supposing that it travels straight at the rate of 30 ft. per second

**34** "Two monkeys were sitting at the top of a tree 100 cubits high one of them got down the tree and proceeded to a well 200 cubits from the foot of the tree The other one jumped a certain distance above the tree and then came down obliquely in a straight line to the well. If the same distance was travelled by the two, find the height jumped by the monkey" [Lilavati]

**35** Given that the greatest and the least heights of a verandah 5 ft wide are 13 ft. & 7 ft., find the width of the roof.

**36** A rectangle ABCD contains an acre and AB is  $2\frac{1}{2}$  times AD If two persons P and Q start at the same time from A and arrive simultaneously at C, the former travelling along AC and the latter along AB and BC, compare their rates of travelling

**37.** Given that the area of  $\Delta$  is equal to  $\frac{1}{4} s(s-a)(s-b)(s-c)$  where  $a, b$  and  $c$  are the sides and  $s$  the semiperimeter of the trian-

gle, find the area of a triangle whose sides are (1) 28 in, 31 in. & 43 in and (2) 72 in, 63 in. & 54 in.

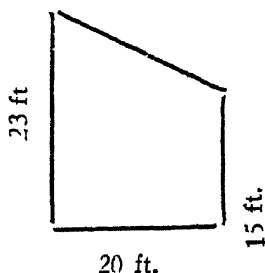
38. ABC is a triangle in which  $a = 3.2 \text{ cm.}$ ,  $b = 3.7 \text{ cm.}$  and  $c = 4.5 \text{ cm.}$  Find the length of the perpendicular drawn from A to BC (1) by drawing and (2) by calculation.

39. By selling an article for a profit of Rs 16 a person gained as much per cent as the article cost him in rupees Find the cost price of the article

40. The foot of a ladder 35 ft long is 21 ft from a house and its top reaches the upper part of a circular window. When its foot is drawn away to a distance of 25 ft. from the house, the top reaches the lower edge of the window. What is the diameter of the window?

41. "One pillar is 5 hastas (20 feet) in height similarly another pillar which is the taller is 23 hastas in height. The length of the intervening space between the pillars is 12 hastas. The top of the broken taller pillar falls on the top of the other pillar. Find out the height of the standing part of the broken taller pillar." [Ganitasara-sangraha.]

42. The figure represents a cowshed 30 ft long with dimensions as given in the figure. Find the cost of roofing it at 4 as a sq. yard and the cost of flooring it at 2 as. a sq. yd.



43. A cord 85 ft long when fully stretched reaches from the top of a pole 51 ft high standing vertically to a point on the ground. A shorter pole is placed vertically, between the foot of the longer pole and the point at a distance of 44 ft. from the point and it is found that the cord just touches the top. Find the height of the longer pole over the shorter, given that the length of the cord between them is  $\frac{1}{7}$  of its whole length

44. Three poles planted at the angular points of an equilateral triangle of side 12 ft. measure 12 ft., 16 ft. and 20 ft. above the ground. Show that the lines joining the tops of the poles from the sides of an isosceles triangle and find their lengths

## EXERCISE VII

### Compound Interest

[N.B.—*Answers must be given correct to a pie or penny*]

1. Find the amount and the compound interest on—
  - (a) Rs. 1,200 for 3 years at 7% per annum
  - (b) Rs. 1,250 for 2 years at  $6\frac{1}{2}\%$  per annum.
  - (c) £. 1,425 for  $2\frac{1}{2}$  years at 4% per annum
  - (d) Rs. 112-8 for 2 years at 8% per annum
  - (e) £ 433-6-8 for 2 years at 5% per annum
  - (f) £ 300 for  $2\frac{1}{4}$  years at 6% per annum
2. Find the compound interest on Rs. 15,000 for 3 years at 5% per annum, interest being payable half yearly.
3. Find the amount at C. I. for Rs. 2,500 for 1 year at 8% per annum, interest being payable quarterly
4. Find the compound interest on £ 500 for  $1\frac{1}{2}$  years at 6% per annum, interest being payable half yearly
5. Find the compound interest on Rs. 1,250 for 4 years at 8% per annum, interest being payable once in 2 years.
6. A tradesman invested Rs. 2,000 in a bank which paid him 6% per annum, the interest being added to the capital every year. If the bank failed at the end of three years and a dividend of 11 as 3 ps in the rupee was declared, find how much he got from the bank
7. A person saved Rs. 500 every year and invested them in a bank at the beginning of the next year at 6% per annum. If the first investment was made on 2—1—1917, find how much he was worth on 1—1—1920. (The interest is compounded with the principal at the end of every year)
8. If, in question 7, the bank failed at the end of the year 1919 and a dividend of 7 as 5 ps. in the rupee was declared, find how much he would have got from the bank on 1—1—1920.
9. A person borrowed Rs. 1,200 at 8% per annum C. I. If he repaid Rs. 400 at the end of every year, find when the debt will be cleared and the value of the last instalment
10. A merchant borrowed £68,962 on condition that at the end of each year, he should pay back a portion of the principal with interest at 5% on the amount standing unpaid during that year. Show that the debt can be cleared in 4 years by an annual payment of £19,448-2-0
11. A company borrows Rs. 33,17,550 on condition that at the end of each year a portion of the principal should be paid with interest at 4% per annum on the amount standing unpaid during that year.

Show that the company will clear the debt in 4 years by paying Rs 9,13,952 every year

**12.** A sum of Rs. 5,000 is lent on condition, that, if it is not repaid within a year, compound interest will be charged. The option is given of 6% per annum throughout or 3% for the first year, 5% for the second year and 7% for the third year and so on, the rate increasing by 2% every year. Find the difference in the amounts according to the two systems, if the loan is paid at the end of the fourth year.

**13.** The difference between the simple interest and the compound interest on a certain sum for 3 years at 5% per annum is Rs 266—14—0, find the sum lent

**14** If the simple interest on a certain sum of money for 2 years at 6% per annum is Rs 54 less than the compound interest on the same sum for the same time at the same rate, find the sum lent.

**15** Rama lent a certain sum to Krishna for 2 years at 8% per annum. At the end of the period a dispute arose as to whether simple or compound interest should be calculated. If the sum in dispute is Rs 8, find the sum lent.

**16** Govind borrowed a certain sum at 4% per annum S 1 and forthwith lent it to Krishna at the same rate of interest, interest being added to the principal at the end of every year. If all the transactions were closed at the end of 2 years and Govind gained Rs. 18—12—0 in the bargain, find the sum lent

**17** Rama lent Govind a certain sum at 8% per annum for 2 years. A dispute arose whether the interest should be compounded with the principal yearly or half yearly. If the sum in dispute was Rs 864' 64, find the sum lent.

**18** A person has a property worth Rs 12,000. If its value increases every year by  $\frac{1}{4}$  of its value at the beginning of the year, find its value at the end of three years.

**19.** The population of a town was 90,000. The death rate per annum was 28 per 1,000 and the birth rate 33 per 1,000 of the population at the beginning of the year. Find the population at the end of 3 years

**20.** The population of a village is 7,000. Annually 5% die and the number of births is 3% of the population at the beginning of the year and 50 people emigrate. Find the population at the end of 3 years.

**21.** Derive the formula  $A = P \left\{ 1 + \frac{r}{100} \right\}^n$

22. If  $A = \text{Rs } 1,764$ ,  $n = 2$  and  $r = 5$ , find  $P$

23. What sum will amount at C. I. to—

(a) Rs 9,317 in 3 years at 10% per annum ?

(b) Rs 17,576 in 3 years at 4% per annum ?

(c) Rs. 28,561 in 2 years at 8% per annum interest being payable half yearly ?

(d) Rs. 4,913 in  $1\frac{1}{2}$  years at  $12\frac{1}{2}\%$  per annum, interest being payable half yearly ?

24. At what rate per cent per annum C. I. will—

(a) £ 1—13—4 amount to £ 1—16—9 in 2 years ?

(b) £ 166—13—4 amount to £ 176—16—4 in 2 years ?

(c) £ 1,000 amount to £ 1,102—10—0 in 2 years ?

25. In what time will Rs 1,000 amount to Rs 1,331 at 10% per annum C. I. ?

26. In what time will £ 250 amount to £ 270—8—0 at 4% per annum C. I. ?

27. A machine was worth Rs 3,500 at the beginning of 1916. If its value depreciated every year by 5% of its value at the beginning of the year, find its worth on the 1st of January, 1919

28. A machine was worth Rs 17,280 on the 31st of December, 1918. If its value depreciated every year by  $8\frac{1}{3}\%$  of its value at the beginning of the year, find the value on 1—1—1922

29. A machine was worth Rs 6,52,500 on the 1st of January, 1919. If its value depreciated every year by  $16\frac{2}{3}\%$  of its value at the beginning of the year, find the value on (1) 1—1—1921 & (2) 1—1—1917

30. A machine was worth Rs. 10,240 on the 1st of January, 1920. If its value depreciated every year by  $11\frac{1}{3}\%$  of its value at the beginning of the year find its worth on the 1st of January, 1917

31. A rice mill was worth Rs 5,120 at the beginning of a certain year. If its value depreciated each year by  $\frac{1}{16}$  of its value at the beginning of the year, find its worth at the end of 2 years

32. In an air pump one-fifth of the air in the receiver at the beginning of the stroke is removed at each stroke. At how many strokes will the volume of air left be less than half that of the air at the beginning of the operation ?

33. Write down a formula for the amount produced at C. I. by £ $a$  in  $t$  years at  $r\%$  per annum, when the interest is paid  $p$  times a year

**34.** What sum will at C. I. amount to Rs. 3,822 in 2 years, the rate of interest being 4% per annum for the first year & 5% per annum for the second year? What would have been the amount if the rates of interest for the two years be interchanged?

**35.** What sum would in 3 years amount to £ 2,811—18 s. at C. I. if the rates be 3% per annum for the first year, 4% per annum for the second year, and 5% per annum for the third year? What would have been the amount if the rates of interest for the first, the second and the third year be respectively 5%, 4% & 3% per annum, compound interest being charged

**36.** A man borrows Rs. 1,800 at 8% per annum S. I. and forthwith lends it as follows (1) Rs. 800 to A at 10½% per annum S. I. (2) Rs. 600 to B at 10% per annum C. I. and the remainder to C at 12½% per annum for the first year and 12% per annum for the second year, the interest being compounded with the principal at the close of the first year. At the end of two years he collects the amounts due to him from A, B and C and pays his dues to his creditor. How much does he gain? (S. S. L. C. 1919)

**37.** A person borrowed Rs. 1,200 at 6% per annum S. I. and forthwith lent Rs. 800 to A at 7% per annum C. I. and the remaining sum to B at 8% per annum C. I., interest being payable half yearly in the second case. At the end of two years he collected the sums due to him from A and B and discharged his debt. How much did he gain?

**38.** Two brothers, Rama and Govind, shared equally between them a capital of Rs. 10,000. The former lent it forthwith at 7% per annum C. I. interest being payable half yearly. The latter bought 2½ acres and let them for a plantain dealer for a rent of Rs. 600 payable at the end of two years. If, at the end of two years, the lands have risen in value by 5%, find which of the two is the gainer and by how much at the end of two years.

**39.** A merchant started a business with a capital of Rs. 750. In the first year he increased his capital by 10%, in the second year he increased the then capital by 8% and in the third year he increased the then capital by 6%. What difference would have been caused, if he had uniformly increased his capital every year by 8%?

**40.** A man bought 3 acres of land for Rs. 6,000. He planted 3,000 casuarina trees in each acre, 30% of which withered away in the course of two years. He then sold the rest at an average rate of Rs. 1-4 a tree. If the expenses of the business amounted to 40% of the sale

proceeds and the lands rose by  $3\frac{1}{2}\%$  in the value at the end of 2 years, find what rate of interest per annum C I he would have realised

**41** The population of a town in 1901 was 807,953. If it increased every decade by 5% of the value at the beginning of the decade, find its population in (1) 1921 and (2) 1881.

**42.** Rama borrowed on 1—1—1917, Rs 1,500 at 6% per annum C. I. and forthwith lent it to Govind on condition that he should give 20 kalams of paddy at the end of each year. The loan was repaid. A kalam of paddy was worth Rs 5, Rs 6 and Rs 7 at the end of the 1st, 2nd and 3rd year respectively and the amount realised by selling the paddy was forthwith lent at 8% per annum S.I. If all the transactions were closed on 1—1—1920, find Rama's gain.

**43** Complete the following —

Principal	C. Interest	Amount	Time	Rate % p. a
		Rs 220-8 as.	2 years.	5
£ 750	£ 92-14 s.		2 years.	
£ 2,000.		£ 2,247-4-s		6

**44** Find the sum which will amount at C. I. in 2 years to £ 1,478—15 s. and in 3 years to £ 1,537—18 s.

**45** A lent at the same time and at the same rate equal sums to B and C. B cleared the debt at the end of 2 years by paying Rs. 5,281 4 as and C cleared his debt at the end of 3 years by paying Rs. 5,492 8 as. Find the rate of interest and the sum lent. (Compound interest is charged in the two cases)

**46** A certain sum is put out at C. I. for 4 years at 5% per annum. The interest for the third year exceeds that for the second year by Rs 13—2—0. Find the original sum and the amount at the end of 4 years.

**47** A vintner borrowed £1,200 at 4% per annum C. I. and forthwith bought wine at £ 1—5 s a gallon. He kept it for 3 years. Every year 2% of the quantity at the beginning of the year was sold. If he sold it at the end of 3 years at £ 1—14 s. a gallon and cleared his debt, find his gain.

**48** A merchant borrowed a certain sum at 6% per annum C.I. and cleared the debt by paying £ 4,000, £ 4,500 and £ 5,623—6 s at the end of the first, the second and the third year respectively. Find the sum borrowed.

**49.** A person borrows Rs 25,220 at 5% per annum C. I. and repays the loan in equal instalments at the end of the first, the second and the third year. How much does he pay each year?

**50.** A person borrows Rs. 16,340 at  $6\frac{1}{2}\%$  per annum C. I. and repays the loan in equal instalments at the end of the first, the second and the third year. How much does he pay each year?

### EXERCISE VIII.

**Circle** ( $\pi = \frac{22}{7}$ )

**1** How many times will a wheel whose radius is 1 ft. 9 in. turn round in travelling one mile?

**2** How many revolutions are made by the driving wheel of a tricycle 36 inches in diameter in travelling 2 miles 7 furlongs?

**3.** How far has a bicycle travelled when its driving wheel 30 in in diameter has made 3,360 revolutions?

**4** The driving wheel of a locomotive engine 7 ft. in diameter makes 100 revolutions a minute. At what rate is the train travelling?

**5** A three mile race is to be run on a circular track whose radius is 105 yds. How many times must the winner run round the track?

**6.** The minute hand of a watch is 2'1 cm. long. Find the area swept over by the minute hand in an hour.

**7** A circular field is 280 yds in diameter. Find the cost of levelling it at 3 ps. a sq. yd. and that of fencing it at 2 as. a yard.

**8.** A wall 24 ft  $\times$  18 ft has one door 6 ft  $\times$  4 ft. and two windows each 4 ft.  $\times$  3 ft. and four circular ventilators each 1 ft. 2 in diameter. Find the cost of whitewashing it at 1 pie a sq. ft.

**9.** The cost of fencing a circular field at 1 a. 4 ps. a foot is Rs. 220. Find the cost of levelling it at 1 pie a sq. yard.

**10.** A wire 44 ft. long is bent into a square and another wire of the same length is bent into a circle. Which of the two encloses a greater area and how much?

**11.** Find the length of a side of a square whose area is equal to that of a circle of radius 14 ft.

**12.** A farmer in Australia wishes to enclose 1,000 acres and surround them with a fence at 1 s. a yard. Which shape ought he to

choose, a square or a circle, so that he may have them fenced for a cheaper amount? By how much is the one cheaper than the other?

**13.** A wire may be so bent as to enclose a square whose area is 121 sq. inches. If a wire of the same length were bent in the form of a circle, what would be the length of its diameter?

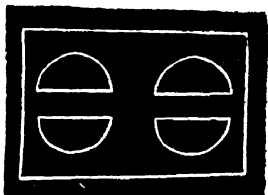
**14.** The radii of two circles are 5 in. and 12 in. Find the radius of the circle, whose area is equal to (1) the sum of the areas of the two circles and (2) the difference between their areas

**15.** A cow tethered is allowed to feed on  $2\frac{1}{2}$  acres of ground. How many yards long is the rope with which it is tied?

**16.** From a circular tin piece of radius 7 inches a square of side 7 inches is removed. If the square piece weighs 140 grams, find the weight of the remaining piece

**17.** A circular hole is to be cut in a circular plate whose diameter is 6 in. so that the weight of the plate is reduced by 25%. Find the diameter of the hole.

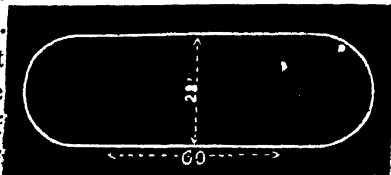
**18.** A rectangular garden 60 ft by 40 ft has 4 semi-circular beds of radius 10 ft 6 in., as shown in the figure. Find (1) the cost of fencing the garden and the beds at 3 as a yard, (2) the cost of levelling the beds at 1 pie a sq yd and (3) the cost of gravelling the rest of the garden at 8 ps. sq. ft



**19.** An arch is in the form of a rectangle with a semi-circle above it. If the greatest and the least heights of the arch are 13 ft and 10 ft. find the area of a vertical section of the arch

**20.** A flower bed is in the form of a square with semi-circles described on the sides outside. If a side of the square measures 7 ft., find (1) the cost of fencing the bed at 4 as a yard and (2) the cost of levelling it at 2 ps. a sq. yard

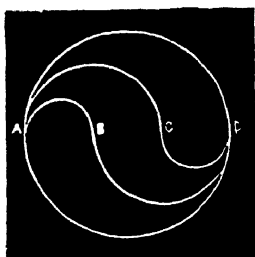
**21.** A hall 60 ft. by 28 ft. has semi-circular wings at the two ends. Find the cost of paving the floor at 4 as. a sq. yd. What must be the width of another rectangular hall of equal area without such wings, if the length is 30 yds. 1 ft?



**22.** A square field has an area of  $3\frac{1}{2}$  acres. Find the area of the circle having the diagonal of the square for its diameter.

23. The legs of a pair of compasses are each 1 foot long. Find the area of the circles described when the angle between the legs is (1)  $60^\circ$  and (2)  $90^\circ$ .

24. ABCD is a straight line in which B and C are the points of trisection of AD. Semi-circles are described on AB, AC, BD and CD as shown in the figure. Show that the circle on AD as diameter has been divided into three equal parts and that all the lines connecting A and D are equal.



25. Find, in rupees, the cost of fencing a circular field of  $r$  feet radius at  $c$  annas a yard.

26. A field is enclosed with a barbed wire fence in which are three rows of the barbed wire, find the cost of the wire if the distance round the field is 1 mile 160 yards and the cost of wire £ 14 per ton. (The weight of 100 yards of wire is 25 lbs.)

27. A circular plot of ground of radius 14 ft. is under grass with the exception of a sheet of water in the middle in the form of a square measuring 7 ft diagonally, and is surrounded by a gravel walk 3.5 feet wide. Find the area of the grass plot and of the gravel walk.

#### EXERCISE VIII b.

##### Plane Circular Ring ( $\pi = \frac{22}{7}$ ).

1. Find the area of a ring whose internal and external radii are respectively 6 inches and 8 inches.

2. The external diameter of a ring is 14 ft. and its width is 2 ft. Find the area of the ring.

3. From a circular cardboard of radius 10 inches a circular piece of diameter 8 inches is removed. If the weight of the piece removed is 20 grams, find the weight of the remaining piece.

4. A circular lawn 154 yards in diameter is surrounded by a path 8 ft wide. Find the cost of levelling the path at 6 ps a sq. yd.

5. The ring enclosed between two concentric circles has an area of 1,320 sq. inches and the inner radius is 8 inches. Find the width of the ring.

6. The external radius of a plane circular ring is 22 ft. and the area of the ring is 264 sq. ft. Find the internal radius.

7. A half mile race is run on a perfectly circular course, the track being 3 yds. wide. Three times round the course on the inner

edge is half a mile. Find the cost of enclosing the track inside and outside with rope at 3 ps. a yd. and the cost of levelling it at 1 anna a sq. yd

8. A circular mirror of radius 1 ft. is surrounded by a circular gilt frame 2 in. wide. If resilvering the frame costs 3 as. per sq inch and resilvering the glass, 9 pies per sq. inch, find the cost, to the nearest anna, of doing up the mirror

### EXERCISE VIII c.

**Sectors.** ( $\pi = \frac{22}{7}$ ).

1. Find the area of a sector of a circle of radius 1'75 inches, the angle at the centre being (1)  $60^\circ$ , (2)  $75^\circ$ , (3)  $135^\circ$ , (4)  $160^\circ$ .

2. Find the area swept over by the minute hand of a watch 1'4 inches long in moving from 3 to 7.

3. ABCD is a square grass field containing  $2\frac{1}{2}$  acres. A cow is tethered at A by a rope equal in length to that of AB. Find the area over which the cow cannot graze.

4. What area does a pendulum 70 cm. long sweep in moving through  $30^\circ$ ?

5. The angle of a sector is  $36^\circ$  and its radius is 10 ft. Find, to two places of decimals, the side of a square whose area is equal to that of the sector.

6. Find, to the nearest inch, the radius of a circle whose area is equal to 3 times the area of a sector of a circle of radius 6 ft. and central angle  $72^\circ$ .

7. Find the length of the arc of a sector of a circle of radius 7 inches and angle at the centre  $30^\circ$ .

8. Find the perimeter of a sector of a circle of radius 1'4 inches, the angle at the centre being  $45^\circ$ .

9. The length of the arc of a sector is 4 ft. and the radius is 7 ft. Find the area of the sector and the central angle.

10. The angle of a sector is  $72^\circ$  and its area is 770 sq inches. Find the length of the arc

11. The angle of a sector is  $40^\circ$  and its area is 154 sq. inches. Find the radius and the length of the arc.

12. The perimeter of a sector of a circle of radius 3'5 in. is 9'2 in. Find the area of the sector.

13. What is the magnitude of the angle at the centre of a circle subtended by an arc equal to half the radius?

14. The perimeter of the sector of a circle is 19'5 inches and the angle at the centre is  $45^\circ$ . Find the radius of the circle and the area of the sector.

15. What is the length of the arc described by the extremity of a minute hand 7 in. long in 40 minutes?

16. The minute hand of a clock makes an arc of 11 inches in 10 minutes. Find the length of the minute hand.

17. How many minutes will a minute hand 6 in. long take to sweep over an area of  $4'7124$  sq. inches?

18. A pony is tethered by a rope to a corner of a triangular field, the sides passing through the point being 160 yds. and 200 yds. in length. If the sides include a right angle and the rope is 35 yds. long, find the area of the field ungrazed by the pony.

19. PQRS is a square piece of paper. A quadrant of a circle with P as centre and PQ as radius is removed. If the remainder contains  $86'84$  sq. inches, find the length of a side of the square. ( $\pi = 3'1416$ )

20. The adjacent sides AB and AD of a rectilinear field measuring 120 yds. and 76 yds. contain an angle of  $45^\circ$ . A cow is tethered at A by a rope 66 yds. in length. Find the area over which it can graze.

21. The area of an equilateral triangle is  $173'205$  sq. ft. About each angular point as centre a circle is described with radius equal to half the length of a side of the triangle. Find (1) the area of the space included between the circles and (2) the area of the 3 sectors which lie outside the triangle.  $\sqrt{3} = 1'73205$ .

22. Find the area of the greatest sector that can be cut out from an equilateral triangle of side 10 cm.

23. With the angular points of a square of side 10 inches as centres four circles are described, the radius of each circle being 5 in. Find the area of the space included between the circles.

24. With the angular points of a regular hexagon as centres six equal circles are described. If a side of the hexagon is 8 inches and the radius of each circle is 4 inches, find the area of the figure enclosed between the circles.

### EXERCISE IX.

#### Cubic Measure

1. How many rafters each 8 ft. long, 4 in. thick and 3 in. wide can be cut from a log of wood 24 ft. long, 2 ft. high and 3 ft. thick?

2. Find the number of books each  $9\text{ in} \times 4\text{ in} \times 2\text{ in}$ . that can be packed in a box whose internal dimensions are  $18\text{ in.} \times 12\text{ in} \times 9\text{ in}$

3. How many cartloads of earth will be dug out of a trench 60 ft. long, 5 ft. deep and 4 ft wide supposing that one cartload occupies 30 cub. ft ?

4. Find the volume of a brick  $9\text{ in.} \times 4\text{ in} \times 1\frac{1}{2}\text{ in}$ . How many such bricks will be required to build a wall 20 yds. long, 6 ft high and  $1\frac{1}{2}\text{ ft.}$  thick, supposing that 5% of the whole space is occupied by mortar ? Express the result to the nearest hundred

5. Water stands to a depth of 6 inches in a rectangular field 120 ft. by 56 ft. Find the weight of water in tons if 1 cub. ft of muddy water weighs 63 lbs.

6. A kerosine tin measures  $60\text{ cm.} \times 35\text{ cm} \times 35\text{ cm}$ . It is three-fourths full Find the weight of kerosine in the tin if one litre weighs  $\frac{8}{9}$  of a kilogram

7. The earth taken out of a trench 64 ft. long,  $2\frac{1}{2}\text{ ft.}$  wide and  $4\frac{1}{2}\text{ ft.}$  deep is spread over a square garden of side 24 ft. Find by how many inches the level of the garden has been raised.

8. A bar of gold 20 cm. long, 2 cm wide, and 1 cm thick is beaten into gold leaves each 10 cm by 8 cm How many gold leaves, will be obtained, if 25 leaves in thickness go to a millimetre ?

9. A well 30 ft. deep is dug outside a field whose area is  $\frac{1}{2}$  an acre. If, when the earth taken out is spread over the field, its level is raised by  $1\frac{1}{4}\text{ in.}$ , find the length of a side of its (well) base which is a square.

10. Find the corresponding result in the previous question if the well is dug inside the garden

11. A horse can draw 800 kilograms. How many horses are required to draw a block of granite  $2\frac{1}{2}\text{ metres} \times 1\frac{1}{2}\text{ metres} \times \frac{1}{2}\text{ metre}$ , if a cub metre of granite weighs 2,750 kilograms ?

12. The solid contents of a box are 58 cub. ft 1344 cub. inches, the width is 5 ft 4 in. and the length is 3 times the depth. Find its length and depth.

13. A cubic foot of gold weighs 1,200 lbs and a sovereign weighs 117.6 lb. How many sovereigns can be made from a gold bar  $3\frac{1}{2}\text{ ft.}$  long, 11 in. wide and 1 ft. thick ?

14. A room is  $20\text{ ft.} \times 14\text{ ft.} \times 12\text{ ft.}$  How many persons can it accommodate if each person requires 120 cub. ft. of space.

15. A school room is 32 ft.  $\times$  18 ft.  $\times$   $10\frac{1}{2}$  ft. How many children will it accommodate allowing 8 sq. ft. of the floor for each and how many cub. ft. of space will there be for each?

16. A rectangular granary 16 ft. high has a square base of side 12 ft. It is three-fourths full of paddy. If each bag is sold for Rs. 8—12 as, find the amount realised by selling the whole, one bag of paddy occupying 8 cub. ft.

17. A tin plate 20 cm. long and 15 cm wide weighs 60 grams. If one c. cm. of tin weighs 4 grams, find its thickness.

18. By how many inches will the level of the water be raised in a rectangular vessel 4 in. long, 3 in wide and 5 in. high, when a glass cube of edge 2 in. is immersed in it?

19. A kerosine tin 16 in high has a square base of side 10 in. It is four-fifths full of oil. Find the amount realised by selling it at 2 as. 6 ps. a bottle, if one bottle occupies 48 cub in.

20. A cub. ft of copper weighing 560 lbs. is beaten into a bar 4 ft long and its cross section is a square. What is the weight of the greatest cube that can be cut from the bar?

21. A rectangular cistern 5 ft  $\times$  4 ft  $\times$  3 ft. 8 in. has 30 cub ft. of water in it. Porous bricks are placed into the water, until the cistern is brimful, each brick absorbing one-fifth of its own volume of water. How many bricks can be put in without the water overflowing, each brick being 9 in.  $\times$  3 in.  $\times$   $2\frac{3}{4}$  in.?

22. A cubical block of ice of edge 18 in. is placed in a rectangular vessel whose base is a square of side 24 in. Find the depth of water after the ice has completely melted, supposing 1 gram of water occupies 93% of the volume of the same weight of ice

23. A rectangular cistern 10 ft.  $\times$  5 ft  $\times$  3 ft contains pulp for making paper. If half the volume of the pulp is lost in drying, how many sheets of paper each 24 in.  $\times$  16 in. will be obtained, if 400 sheets in thickness go to an mch?

24. If  $6\frac{1}{4}$  gals. = 1 cub. ft. and water while freezing increases by expansion .089 of its bulk, how many gallons of water are required to cover a rink 110 yds.  $\times$  96 yds. with ice  $5\frac{1}{2}$  in. thick?

25. The water supply of a village of 5,700 inhabitants is made by a pipe 150 sq inches in section and the water flows along the pipe steadily at 2 miles an hour throughout the day. Give, to the nearest ten thousand gals the total daily water supply, and also to the nearest gal the daily supply per head.

**26.** A box is made of wood  $\frac{1}{2}$  inch thick, and when closed, its external dimensions are  $9\frac{1}{2}$  in., 9 in. and 7 in. Find its weight if 3 cub in. of the same wood weigh 1 oz.

**27.** A box without a lid made of wood half an inch thick measures on the outside 79 in.  $\times$  18 in.  $\times$  14 in. Find (1) the cubical contents of the box (2) the cost of painting the outside (base excluded) at 4 as. per sq. ft (3) the cost of lining the inside with tin sheets at 8 as. per sq. ft.

**28.** The external dimensions of a closed cistern are 10 in.,  $8\frac{1}{2}$  in. and 6 in. the thickness of the material being  $\frac{1}{2}$  an inch. When the vessel is empty, it weighs 160 oz. What does it weigh when full of water, 1 cub. ft. of water weighing  $62\frac{1}{2}$  lbs. ?

**29.** The external dimensions of a rectangular open vessel are 12 in., 7 in. and 6 in., the thickness of the material being  $\frac{1}{2}$  an inch. When the vessel is empty, it weighs 40 ounces Find the weight of a cub. ft. of the material.

**30.** A garden 120 ft long and 80 ft broad has a path 6 ft. wide running round it outside. Find the cost of gravelling the path with gravel 6 in. deep at 4 as. a cub. yard.

**31.** A moat 15 ft. deep and 20 ft wide is dug round a fort, 200 ft. by 160 ft. How many cartloads of earth will be removed, one cartload of earth occupying 40 cub. ft ?

**32.** The external dimensions of a box are  $a$  in.  $b$  in. and  $c$  in. and the thickness of the wood is  $d$  in. Find the internal dimensions of the box and the volume of wood contained in it when the box has (1) a lid and (2) no lid.

**33.** A garden  $a$  ft. by  $b$  ft. has a path  $c$  ft. wide all round it outside. Find the the cost of gravelling it with gravel  $d$  in. deep at  $r$  Rs. per cub. yd.

**34.** A box made of wood 1 in thick measures when closed  $a$  in  $\times b$  in.  $\times c$  in. Given that one cub. in. of the material weighs  $g$  grams and one cub. in. of sand weighs  $s$  gms., find the weight of the box (1) when empty and (2) when half filled with sand.

**35.**  $a$  cartloads of earth are spread over a rectangular field  $l$  ft. by  $b$  ft. If the level is thereby raised by  $d$  in. and if one cartload of earth occupies  $c$  cub. ft., find a relation connecting  $l$ ,  $a$ ,  $b$ ,  $c$  &  $d$ .

**36.** Passengers by a certain line of steamers are allowed, 20 cub. ft of luggage. A passenger wishes to take two boxes, each 3 ft. long and  $2\frac{1}{2}$  ft broad and of the same height. What is the great-

est height he can have them made so as not to exceed the limit allowed?

37. Find the length of the diagonal of a rectangular solid  $7\frac{1}{2}$  in.  $\times$   $9\frac{1}{6}$  in.  $\times$   $3\frac{1}{5}$  in.

38. A rectangular room is 24 ft.  $\times$  16 ft.  $\times$  14 ft. Find the distance from one top corner to the opposite bottom corner.

39. The three edges of rectangular parallelepiped that meet at an angle are respectively 25 ft., 54 ft. and 160 ft. Find the diagonal of the cube which has the same volume.

40. If I pay one guinea for a cubical block of marble a side of which measures 1 ft., what should I pay for another cubical block of the same marble a side of which is equal in length to the diagonal of the first block?

41. The cost of a cube of metal at 4 s. 6 d. per cub. in. is £ 8-6-8. Find the cost of gilding its surface at 1 d. per. sq. inch.

42. A statuette 16 in. high is to be made of copper; a plaster model 3 ft. high weighs 120 lbs. Find the weight of the copper statuette, copper being  $11\frac{1}{2}$  times as heavy as plaster

43. A rectangular field ABCD which is a third as long again as it is broad contains 3 acre. A pole 48 ft. high is planted at A. Three monkeys start from C and proceed to the top of the pole P. The first goes along CB, BA and AP, the second along CA and AP, and the third along CP. If all the three reach P at the same time, compare their speed.

## EXERCISE X.

### Symbolical Expression Part I.

1. The length and the breadth of a room are  $a$  metres  $b$  cm. and  $c$  metres  $d$  cm. Find the area in (1) sq. metres and (2) sq. cm.

2. A rectangle is  $l$  yds.  $m$  ft. long and  $b$  yds.  $n$  ft. broad. Find the cost in rupees of paving it at  $c$  annas a sq. ft.

3. A person exchanged  $a$  sheep worth Rs.  $b$  each for  $c$  cows worth Rs.  $d$  each. Express  $c$  in terms of  $a$ ,  $b$  and  $d$ .

4. A merchant bought  $a$  cows at Rs.  $p$  each and  $b$  cows at Rs.  $q$  each. If he sold them for a profit at an average price of Rs.  $r$  each, find an expression for his gain.

5. A can travel  $a$  miles in  $x$  hours, while B can travel  $b$  miles in  $y$  hours. How many miles more than B can A travel in  $z$  hours? If  $a=16$ ,  $x=4$ ,  $b=6$ ,  $y=2$  and  $z=4\frac{1}{2}$ , find the numerical value of the result.

6. A merchant bought  $a$  cows for Rs.  $b$ . He fed them at a cost of  $c$  as. per cow per day. At the end of  $d$  days two cows died and the rest were sold at Rs.  $r$  each. Find his gain.

7.  $a$  men are each  $x$  ft high,  $b$  are each  $y$  ft., and  $c$  are each  $z$  ft. high. Give their average height.

8. The average age of a class of  $p$  boys is  $a$  years and that of  $q$  of them is  $b$  years. Find the average age of the rest.

9. The average age of  $x$  boys is  $a$  years and that of  $y$  other boys is  $b$  years. Find the average age of the whole. Evaluate the expression when  $x=60$ ,  $y=120$ ,  $a=18$  and  $b=21$

10. The average age of a school of  $a$  scholars is  $l$  years. By the enrolment of  $b$  additional scholars the average age is raised to  $m$  years. Find the average age of the new scholars.

11. The average age of a class of  $x$  scholars is  $a$  years. By the removal of  $y$  scholars the average age is reduced by  $b$  years. Find the average age of the  $y$  scholars.

12. If  $a$  eggs cost  $p$  pence and if, at the same rate,  $y$  eggs are bought for  $x$  shillings, express  $y$  in terms of  $a$ ,  $b$  and  $x$ .

13. An oil-monger mixed  $a$  viss of gingelly oil worth Rs.  $b$  a viss with  $c$  viss of ground-nut oil worth  $d$  as a viss. If he sold the mixture at Rs.  $e$  a viss, find his gain. If  $a=8$ ,  $b=1\frac{1}{2}$ ,  $c=3$ ,  $d=14$ , and  $e=1\frac{7}{8}$ , find the numerical value of the result.

14. An article which cost Rs.  $l$  is sold at a profit for Rs.  $m$ . Find his gain per cent. If the cost price and the selling price are both increased by Rs.  $n$ , determine whether the gain per cent. will be increased or diminished and by how much. Evaluate each expression to the nearest integer when  $l=20$ ,  $m=24$  and  $n=2$ .

15. A man bought a cow for Rs.  $c$  and sold it for Rs.  $s$  and thereby gained  $g\%$ . Find a relation connecting  $c$ ,  $s$  and  $g$ .

16. By selling an article for Rs.  $s$  a man lost  $l\%$ . If the total loss be Rs.  $a$ , find a relation connecting  $s$ ,  $l$  and  $a$ .

17. The population of a certain town decreased by  $r\%$  in a given interval. If the original population be  $x$  and the new population be  $y$ , find a relation connecting  $r$ ,  $x$  and  $y$ .

18. In a school of  $x$  boys,  $a\%$  are free and  $b\%$  pay reduced rates. If the remaining  $y$  boys pay full fees, find a relation connecting  $a$ ,  $b$ ,  $x$  and  $y$ .

19. The population of two towns, A and B was  $a$  and  $b$ , the population of the former increased by  $x\%$ , while that of the latter by

$y\%$ . If the increase in the population of the two towns is  $z\%$ , find a relation connecting  $x$ ,  $y$ ,  $z$ ,  $a$  and  $b$ .

20. The total receipts of a railway for one year are Rs.  $r$  of which Rs.  $a$  is received from first class, Rs.  $b$  from second class and Rs.  $c$  from third class passengers and the remainder from goods. In the following year the receipts from first and second class passengers respectively fall  $x\%$  and  $y\%$ , but those from third class and goods rise  $z\%$  and  $w\%$ . Find the receipts for the second year.

21. The percentage of passes in an examination among the boys and girls were  $a$  and  $b$  respectively and  $p\%$  of the total number of candidates passed. If  $x$  boys and  $y$  girls entered for the examination, find a relation connecting  $a$ ,  $b$ ,  $p$ ,  $x$  and  $y$ .

22. By selling mangoes at the rate of  $a$  for  $b$  annas a dealer made a profit of  $c\%$ . What percentage of profit would have been made, if he had sold them at the rate of  $b$  for  $a$  annas?

23. A and B are  $x$  miles apart. They walk towards each other at  $a$  and  $b$  miles an hour respectively and meet  $c$  hours after their starting. Express  $x$  in terms of  $a$ ,  $b$  and  $c$ .

24. A is  $m$  miles ahead of B and travels at  $a$  miles an hour. At what rate should B travel so as to overtake him in  $h$  hours? Find the rate when  $m=10$ ,  $a=3\frac{1}{2}$  and  $h=4$ .

25. A man had to travel  $a$  miles in  $x$  hours. He ran for  $y$  hours at  $m$  miles an hour and rode on his cycle for  $z$  hours at  $n$  miles an hour. If he walked the remaining distance, find an expression for the rate of walking. Evaluate the expression when  $a=40$ ,  $x=6$ ,  $y=2\frac{1}{2}$ ,  $m=6$ ,  $z=1\frac{1}{2}$ , and  $n=10$ .

26. The rate of a stream is  $a$  miles an hour and the speed of a man in still water is  $b$  miles an hour. If a man takes  $h$  hours more to travel  $c$  miles up-stream than to travel the same distance down-stream find a relation connecting  $a$ ,  $b$ ,  $c$  and  $h$ .

27. Find in rupees the simple interest on Rs  $x$  for  $m$  years  $n$  months at  $a$  pias per rupee per mensem.

28. A sum of Rs  $p$  amounts in  $m$  months to Rs.  $q$  at  $c$  pias per rupee per mensem. Find a relation connecting  $m$ ,  $p$ ,  $q$  and  $c$ .

29. A pipe A can fill a cistern in  $p$  hours and a pipe B can fill it in  $q$  hours. If the two pipes together can fill it in  $r$  hours, find a relation connecting  $p$ ,  $q$  and  $r$ .

30. A and B can do a piece of work in  $a$  days, while A alone can do it in  $b$  days. In what time can B alone do it?

31. If a man walks  $p$  miles in  $q$  hours, how far will he walk in  $x$  hours and how long will he take to walk  $y$  miles?

32. If it takes a man  $x$  hours to walk round a square field at the rate of  $y$  miles an hour, find the area of the field in acres.

33. How many sovereigns will it cost to fence a square field containing  $p$  acres at the rate of  $q$  shillings for  $r$  yards?

34. If  $p$  planks,  $f$  ft. long and  $w$  in. wide are required for flooring a room  $d$  yds. long, what is its breadth in feet?

35. It costs Rs.  $c$  to carpet a room  $l$  ft.  $\times$   $b$  ft. with carpet at  $a$  annas a yard. What is the width of the carpet in inches?

36. It costs  $\pounds c$  to carpet a room  $a$  ft. long with carpet  $d$  in. wide at  $s$  shillings a yd. Find the breadth of the room in feet.

37. It takes  $n$  bricks each  $a$  in. long to pave a square court of side  $x$  ft. Find the width of a brick in inches.

38. If  $a$  men reap  $b$  acres in  $c$  days, how many acres will  $p$  men reap in  $q$  days?

39. If 20 horses eat  $x$  bushels of corn in 3 days, and 30 horses eat  $y$  bushels in 4 days, find a relation connecting  $x$  and  $y$ .

40. A room is  $a$  ft.  $\times$   $b$  ft.  $\times$   $c$  ft. Find an expression for the total area of the walls in sq. ft., supposing that the doors and the windows occupy  $p$  sq. ft. If the walls are covered with paper costing  $d$  pence per sq. yd., find an expression for the cost in shillings.

41.  $m$  men and  $w$  women can reap  $x$  acres in a week, while  $M$  men and  $w$  women can reap  $y$  acres in the same time. How many acres will a man reap in a week? How many weeks will it take  $d$  men to reap  $z$  acres? Evaluate the two expressions when  $m=20$ ,  $w=8$ ,  $M=12$ ,  $y=6$ ,  $d=30$  and  $z=15$ .

42.  $a$  men and  $b$  women can reap a field in  $x$  days, while  $a$  men and  $c$  women can reap the same field in  $y$  days. How long will one woman working alone take to reap half the field?

43. A constable runs in pursuit of a thief who had  $h$  hours' start. If the thief is caught  $x$  hours after the constable started, find a relation connecting  $h$ ,  $x$ ,  $a$  and  $b$ , the rates of travelling of the thief and the constable being  $a$  miles and  $b$  miles per hour respectively. If  $h=2$ ,  $a=4\frac{1}{2}$ , and  $b=6$ , find  $x$ .

44. A room  $p$  sq. ft. in area is to be floored with wooden blocks, the flooring to be  $q$  inches thick. Find the cost of the blocks in  $\pounds$  at  $r$  s. a cub. ft.

45. A ton of lead is rolled into a sheet  $m$  in. thick. Find its area in sq. ft. supposing a cub. ft. of lead weighs  $n$  lbs.

46. Supposing one ton of copper is worth £  $a$  and 1 cub. ft. of copper weighs  $b$  oz., find an expression in shillings for the value of  $y$  yds. of copper wire of diameter  $n$  inches.

47. A rectangular sub-way is to be made  $b$  ft. wide and  $c$  ft. high, the earth weighs  $x$  lbs. per cub. ft. How many tons of the earth will be removed in making  $l$  ft. of the sub-way?

48. A steam plough ploughs an acre in  $a$  minutes. Express in hours the time it will take to plough a field  $b$  yds.  $\times$   $c$  yds.

49. A boat goes  $a$  miles up-stream in  $b$  hours and then  $c$  miles down-stream in  $d$  hours. The stream flows  $e$  miles an hour and the boat could go  $f$  miles an hour in still water. Express  $a$  and  $c$  in terms of  $b, d, e$  and  $f$ . If  $a=16, b=2, c=18, d=1\frac{1}{2}$ , what are  $e$  and  $f$ ?

50. Coal is sent to a railway station at  $a$  s. per ton and there is a further charge for delivery of  $b$  s. per ton per mile. Find the cost in £ of  $c$  tons delivered at a place  $d$  miles from the station in terms of  $a, b, c$  and  $d$ . If  $a=21\frac{1}{2}, b=1, c=6\frac{1}{2}$  and  $d=3$ , find the numerical value of the result.

51. By selling an article for Rs.  $a$ , I gained  $b\%$ . Had I sold it for Rs.  $c$ , I would have gained  $d\%$ . Find a relation connecting  $a, b, c$  and  $d$ .

## EXERCISE XI

### Significant Figures and Contracted Methods.

1. Write down the following correct to 3 significant figures —  
7'4249, 74'326; 5 2169, 123596, 263420, 17; 17424, '06398;  
'0070209, 99'73, 59'96, 1'0023, 0'72, 0'09997.

2. Find the product of the following to 4 significant figures —  
(1) 11'28705 and '09315, (2) 7'31035 and '60507, (3) 252'32406 and '00425, (4) 4,726 342 and '042651, (5) 73'065 and '68379, (6) '245 76 and '069807

3. Divide to 4 significant figures —

(a) 58'32967 by 5'2364.

(d) 6 25604 by '00345.

(b) 5 336434 by '52364.

(e) 5768'0432 by 65'0327.

(c) 476'5205 by 28'0432

(f) '003472 by 7'84325.

4. If the diameter of a circle is 3'45 cm find the length of the circumference to 3 places of decimals ( $\pi=3.1416$ ).

5. Express 37'25 metres in inches, (1 metre = 39'37079 inches)

6. Find the area of a rectangle 8'146 in.  $\times$  4'234 in. correct to 4 significant figures.

7. The weight of a body is 7 342 lbs. correct to the last figure. Find the weight in kilograms to the same accuracy ( $1 \text{ lb} = 45357 \text{ K. G.}$ )

8. The number of kilograms to the litre of a liquid can be found from the number of lbs. to the gallon by multiplying by  $0.9983$ . Find the number of kilograms in a litre of a liquid, a gallon of which weighs 123.72 lbs.

9. Find to 3 significant figures the diameter of a circle whose circumference is 87.97 inches ( $\pi = 3.1416$ ).

10. The planet Mercury describes its orbit round the Sun in 87.96926 days, the Earth in 365.2564 days; Neptune in 60,181.11 days. Find, to 3 significant figures, the number of our years in (1) Mercury's year and (2) Neptune's year.

11. The velocity of light is 186,330 miles per second. The distance of the sun is 92,900,000 miles. Find, to the nearest second, how long light takes to travel from the sun to the earth.

12. The lunar month (from new moon to new moon) contains 29.53059 days, the year contains 365.2564 days. Find to 3 significant figures the number of lunar months in a year.

13. The number of deaths in Bengal in 1919 was 1,641,111. Of this 626,756 were children under 10 years of age of whom 278,370 were infants under 1 year of age. Find what percentage of the total deaths was the number of deaths (1) of infants and (2) of children between 1 and 10.

14. The adjoining table gives the number of speakers of Tamil in those districts where it is spoken as a vernacular according to the census of 1891 and 1901.

Name of the district	Census, 1891	Census, 1901
Trichinopoly	1,157,689	1,219,782
Tanjore	2,095,135	2,118,667
Madura	2,081,102	2,258,359
Tinnevely	1,627,915	1,770,125
Pudukottah	353,770	360,362
Coimbatore	1,297,174	1,442,804

Find, correct to one place of decimals, the increase per cent. in the number of speakers (1) in each district and (2) in the six districts taken together.

15. The adjoining table gives the estimated number and the actual number (census 1901) of speakers of the various Dravidian languages in the Madras Presidency.

Name of language	Estimated No	Actual No.
Tamil	16,223,700	17,494,901.
Malayalam	5,425,979	6,022,131
Telugu	19,783,901	20,697,264
Canarese	9,710,832	10,368,515
Kodagu	37,218	39,191

Find, correct to 3 significant figures, by how much per cent. the estimated number is less than the actual number in the case of each of the five languages.

**16.** The following table gives the number of people embracing the different religions prevalent in India, the total population in 1901 being 294,361,056.

Name of the religion	No. of people
Hinduism	207,147,026
Muhammadanism	62,458,077
Christianity	2,923,241
Sikhism	2,195,339
Jainism	334,148
Zoroastrianism	94,190
Judaism	18,228

Find, to two places of decimals, what percentage of the total population embrace each of the different religions.

**17** The following table gives the number of deaths and the cause thereof in all provinces of British India during the two decades 1881—1890 & 1891—1900

Cause of death	No. of deaths in 1881—1890	No. of deaths in 1891—1900
Cholera	306,518	450,502
Small pox	122,772	82,588
Fevers	3,359,927	4,363,055
Dysentery and Diarrhoea	263,608	278,298
Injuries (snake-bite, suicide, etc.)	80,973	90,082
All other causes	934,127	1,396,936

Find, correct to one place of decimals, the increase or decrease per cent (1) in the number of deaths under each head and (2) in the total number of deaths. Also find the percentage of deaths in each case in 1891—1900 to the total number of deaths of that decade.

## EXERCISE XII a.

**\* Chords.**

1 Find the distance of the centre O from a chord 8 in. long the radius of the circle being 5 inches

2 AB is a chord of a circle of centre O and radius 2'5 in. If O is 7 in from AB, find the length of AB

3 A chord of a circle 3 in long is 8 in. from the centre. Find the radius of the circle.

4 A goat is tethered to a peg 20 ft. from a fence If the rope is 30 ft long, find what length of the fence it can nibble.

5 In a circle of radius 8'5 in. there are two parallel chords 7'2 in. and 10'2 in long. Find the distance between them.

6 The chord of an arc is 3 in. and the diameter of the circle is 4 in Find the length of the chord of half the arc, the length of the arc and the height of the arc.

7 The chord of an arc is 12 ft. and the chord of half the arc is 6½ ft. Find the radius of the circle and the length of the arc.

8 The diameter of a circle is 2'5 in. and the chord of an arc is 2'4 in. Find the height and the length of the arc.

9 Find the chord of an arc and the chord of half the arc, if its height is 2'5 cm and the radius of the circle is 9'7 cm

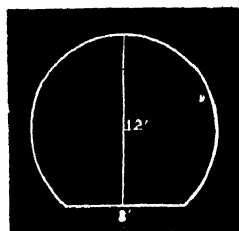
10 The chord of half an arc is 3'5 cm and the height of the arc is 7 cm Find the diameter of the circle and the chord of the arc.

11 The chord of half an arc is 12 in. and the diameter of the circle is 36 in Find the chord of the whole arc and the length of the arc.

12 Find the radius of the circular arch of a bridge whose span is 120 ft and the height of the arch 125 ft

13 A stream 20 ft. wide is spanned by a bridge with a circular arch 7 ft high at the middle. Find the radius of the arc

14 The section of a tube railway is a segment of a circle, the breadth of the tube on the level of the rails is 8 ft, and its greatest height above the rails is 12 ft Draw the section on a convenient scale and find the greatest breadth of the tube.



**N.B.**—In each question find the answer by calculation and verify the result by drawing to scale and measurement.

15. In the case of a figure having the outline of a bow the bow, string is 24 units in measure, and its arrow is taken to be 4 units in measure. Find the measure of the bent stick of the bow [Ganitasarasangraha]

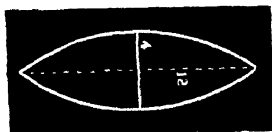
### EXERCISE XII *b*.

#### Segments.

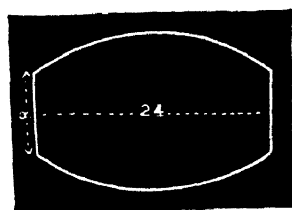
1 Find the area of the segment of a circle whose chord 8 inches in length subtends (1) a right angle, (2)  $60^\circ$ , (3)  $120^\circ$ , at the centre.

2. Find the area of a segment (1) whose chord is 14 in and the radius of the circle is 25 in, (2) whose chord is 30 in. and height 8 in and (3) whose chord is 24 in. and height 5 in.

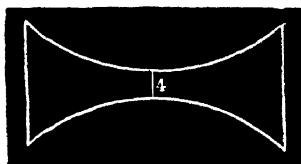
3. The figure resembles the longitudinal section of the *yava* grain. The maximum length is 12 dandas, and the two ends are needle points and the breadth in the middle is 4 dandas. Draw the figure and find its area (1 Danda = 16 ft) [Ganitasarasangraha.]



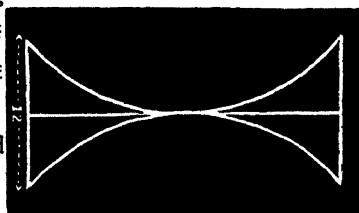
4. In the case of a figure having the outline configuration of a Mridanga, the maximum length is 24 units the breadth of each of the two mouths is 8 units, and the maximum breadth in the middle is 16 units. Draw the figure and find its area. [Ganitasarasangraha.]



5. In the case of a field having the outline of the panava (a kind of drum), the maximum length is 77 dandas, the measure of each of the two ends is 8 dandas and the measure in the middle is 4 dandas. Draw a figure and find its area.



6. In the case of a field having the outline of the vajra, the length is 96 dandas, in the middle there is the middle point, at the ends the measure is 12 dandas. Draw a figure and find its area.



[Ganitasarasangraha.]

## EXERCISE XIII

### Right Prisms

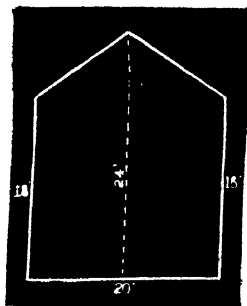
1 Find the volume and the total surface area of a prism 4 ft. high which has for its base (a) an equilateral triangle of side 2 ft. (b) a square of side 2.5 ft and (c) a hexagon of side 2 ft

2. A prism 6 in. high has for its base an isosceles right angled triangle and weighs 120 oz. If a cub. inch of the material of the prism weighs  $2\frac{1}{2}$  oz, find its surface area

3. The ends of a granite column are regular hexagons on a side of 6 in. If the lateral area is 15 sq ft find the height and the weight of the pillar if 1 cub. in =  $2\frac{1}{2}$  oz

4. Find the time taken by a pipe  $1\frac{1}{2}$  in. in diameter to fill a cattle trough 6 ft long, 4 ft. across the top and 2 ft. deep, the section being an isosceles triangle and the rate of flow  $2\frac{1}{2}$  miles per hour.

5 A canal 6 ft. deep is 14 ft broad at the bottom and 22 ft. at the surface of the water. How much water passes every hour through a section of the canal, the rate of flow being 2 miles an hour?



6. A haystack 30 ft long has throughout its length the section shown in the margin. Find, to the nearest ton, the weight of the hay in the stack, 1 cub. ft of hay weighing 6 lbs.

## EXERCISE XIV.

### Right Circular Cylinders.

1. Find the volume of a cylindrical roller 4 ft long and 2.8 ft. in diameter

2. Find the weight of a wooden ruler 16 in. long and 2.1 in. in diameter, 1 cub. in. of wood weighing 6 grams

3 Find the weight of a metre length of a copper wire, .014 cm. in diameter, the density of copper being 8.9 grams per c. cm

4. How many gallons can a cylindrical oil tank 20 ft. high and 14 ft. in diameter hold? (1 c. ft. =  $6\frac{1}{4}$  gals)

5. Find the cost of boring a semi-cylindrical tunnel 30 ft. in diameter and 66 yds. in length at Rs 7 per cub. yard.

6. A tin can is 8 in. high and the diameter of its base is 3.5 in. How many canfuls of oil can a cistern 4 ft.  $\times$  3 ft.  $\times$   $2\frac{1}{2}$  ft hold?

7 How much ink will a fountain pen hold, the depth of the reservoir being 7.5 cm. and the internal diameter 7 mm. ? How often can it be filled up from a half litre bottle ?

8. A cylindrical granary 16 ft. high and 14 ft across the base was full of paddy. Two-thirds of it was sold at Rs 7—8—0 a bag and the remainder at Rs 8—4—0 a bag. If a bag of paddy occupies 8 cub ft, find the total sale proceeds

9. The water contained in a rectangular vessel 6 in.  $\times$  4 in.  $\times$   $4\frac{1}{2}$  in. is poured into a cylindrical vessel the radius of whose base is 3 in. Find the depth of the water.

10. A cube of edge 2.5 in is immersed in the liquid contained in a cylindrical vessel. If the level of the liquid is raised by  $\frac{3}{4}$  inch, find the diameter of the base

11. A circular well 14 ft in diameter and 30 ft deep is dug inside a garden 120 ft  $\times$  80 ft and the earth taken out is spread evenly over the rest of the garden. Find the thickness of the layer of earth.

12. If the well is outside the garden in the previous question, what will be the thickness of the layer of earth ?

13. It costs £ 687 to bore a cylindrical shaft at the rate of 10 s 6 d. for every cubic yard of rock removed. If the diameter of the shaft is 5 ft., find its depth.

14. A strip of paper 20 in. wide, 4 miles long and .0025 in. thick is rolled into a solid cylinder, find, correct to two places of decimals, the diameter of the base.

15. If a cylindrical tank 24 ft. high holds  $148\frac{1}{2}$  tons of water, find its internal diameter (1 cub. ft of water weighs 1000 oz.).

16. Find the area of the curved surface and the total surface area of a cylinder 14 ft. high, the diameter of the base being 8 ft.

17. The radius of the base of a cylinder is 4 in. and its curved surface is 330 sq in. Find its height.

18. Find the cost of painting a solid cylinder of wood 1 ft. 4 in. high, the radius of the base being 5 in., at 12 as. a sq ft

19. How many revolutions will a cylindrical roller 4 ft long and 2 ft 4 in. high make in rolling an acre ?

20. How many sq. yds are covered in 100 revolutions of a cylindrical roller whose length is 4 ft. 6 in. and diameter 2 ft. 9 in. ?

21. Find the superficial area of tin sheet used for making a cylindrical tin vessel (open at the top) 2 ft. 6 in high, the radius of the base being 1 ft. 2 in.

**22.** A cylindrical room with a flat top is on the inside 30 ft. high, and 14 ft. in diameter. Find, to the nearest rupee, the cost of whitewashing it inside including the ceiling, at an average rate of 4 as. per sq. yard.

**23** A coffee pot 2 ft. 1 in. high has for its base a circle of 7 in radius. It is provided with a lid. (1) Find its weight when empty, 1 sq inch of the metal weighing 5 gms (2) How many cups of coffee will it hold, if 1 cup occupies 22 cub in ?

**24** A piece of cardboard 20 in by 8 in is bent so that the two breadthwise ends coincide. Find the height of the cylinder obtained and the radius of its base

**25.** A granite pillar is 20 ft. high, the diameter of the base being 2 ft. Find the cost of polishing it at 8 as. a sq. ft and the weight of the pillar, if 1 cub. ft weighs 168 lbs

**26.** The cost of whitewashing the inside of a cylindrical room 25 ft. high at one pie a sq ft is Rs. 5—11—8. Find the cost of coating the outside with red at 3 as a sq yd., the thickness of the wall being  $1\frac{1}{2}$  ft.

**27.** A cylindrical iron gas reservoir open at the bottom is 18 ft. high and can hold 2772 cub ft of gas. What will it cost, to the nearest rupee, to varnish it inside and outside at 1 a 9 ps. a sq. ft. the thickness of the metal being 2 in ?

**28** Find the weight of a circular disc of cast iron 7 in in diameter and  $\frac{3}{4}$  in thick, if a plate 1 foot square and 1 in thick weighs  $37\frac{1}{2}$  lbs. and the diameter is to the circumference as 7 : 22

**29** In order to find the diameter of a tube of uniform bore some mercury was drawn into it and the height of the column measured. The weight of the mercury was 25.6 grams and the height of the column 15.3 cm. What was the diameter of the tube ? (1 c. cm. of mercury weighs 13.6 gms)

**30.** A circular well 30 ft deep and 6 ft. in diameter is to be dug at 1 a. 6 ps a cub ft. It is then to be lined with brick and chunam one foot thick at 4 as per cub ft. The inside is then plastered at the rate of Rs 3—2—0 per 100 sq ft. Find the total cost of sinking the well to the nearest rupee.

**31** When a coil of wire 0.14 cm in diameter is weighed under water, it loses 3.85 grams in weight. If 1 c. cm of water weighs 1 gram, find the length of the wire.

**32** A metal cube of edge 2 ft. is placed in a cylindrical vessel and water is poured in, till the cube is just immersed. When the

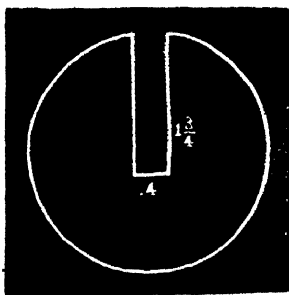
cube is taken out, the level of the water goes down by 2 in. Find, to the nearest inch, the diameter of the base.

**33** The volume of a cylinder 14 in. long is equal to that of a cube of edge 11 in. Compare their total surface areas

**34.** The weight of a cylindrical granite pillar is  $8\frac{1}{4}$  tons and its diameter is 3 ft. If a cub. ft. of granite weighs 168 lbs., find the cost of polishing its curved surface at Re 1—2 as a sq. ft.

**35.** A rain guage has a cylindrical receiving vessel of diameter 2.2 in. The water is collected by means of a funnel of a circular cross section of diameter 10 in. at the top. After a fall of rain the depth of water in the receiver is 2.7 in. Find the depth of the rain-fall to one place of decimals.

**36** Post office weights are 3 inches in diameter and contain a slot (almost rectangular)  $\frac{1}{4}$  inch wide and  $1\frac{3}{4}$  inches long as in the figure. Find in each case the thickness to two places of decimals, when the weights are  $\frac{1}{2}$  lb and 2 lbs. given that 1 cub. in. of iron weighs 27 lb.



**37** A cylindrical gas holder is to contain 3080 cub. ft. of gas, the height being equal to 20 ft. Find its diameter.

If iron plates weigh  $2\frac{1}{2}$  lbs. per sq. ft. find in tons, correct to two places of decimals, the weight of iron plates required in the construction of the gas-holder supposing it to be open at the bottom and closed by a flat top.

**38.** The diameter of a cylindrical boiler with flat ends is 5 ft. and its total surface area is 220 sq. ft. Find its length.

**39.** Find the weight of 20 ft. of iron piping whose external diameter is 1.5 in. and thickness .25 in. (1 c. ft. of iron weighs 486 lbs.).

**40** Find the weight of a hollow cylinder 4 ft. long and of internal diameter 2 ft. 4 in. and thickness 2 in. (1 cub. in. of the material weighs  $3\frac{1}{2}$  oz.).

**41.** A hollow cylindrical iron roller open at both ends weighs 1188 lbs. if its length is 4 ft. and internal diameter 2 ft. 3 in., find its thickness, given that 1 cub. ft. of iron weighs 486 lbs.

**42.** What length of piping  $1\frac{1}{2}$  in. in external diameter and  $\frac{1}{8}$  in. thick can be made from a block of lead  $2\frac{3}{4}$  ft.  $\times$  1 ft.  $\times$  11 in.?

**43** Find the cost of the materials for building a cylindrical tower 60 ft. high and 7 ft. in diameter on the inside with bricks 8 in.  $\times$  4 in.  $\times$  15 in. which cost Rs. 5 per thousand, supposing that one-eighth of the space is occupied by mortar which cost Rs. 10 per 50 cub. ft. Find also the cost of plastering it inside and outside at 7 ps a sq ft, if the wall is 1 ft. thick.

**44.** Find the quantity of water brought in by a pipe 2 in. in diameter in half an hour, the rate of flow being  $1\frac{3}{4}$  miles per hour.

**45.** How long will a pipe 2 in in diameter take to fill a rectangular cistern 4 ft. high with a sq base of side 275 ft, if the rate of flow is 2 miles per hour ?

**46** If one inch pipe fills in 6 minutes a cylindrical tub 2 ft high and 22 in. in diameter, find the rate of flow of water.

**47.** A reservoir standing on a square base of side 40 ft. is supplied with water at a uniform rate by a cylindrical pipe 2 ft. in diameter. At what rate (in ft. per second) must water flow through the pipe, if the level of the water is to be raised by 1 ft. 8 in in 2 minutes ?

**48.** The water in a cistern of 360 gal capacity leaks out through a hole at the bottom in 12 hours. Find the diameter of the hole if the average rate of flow be 60 ft per minute (25 gals = 4 c. ft.).

**49.** If the volumes of two cylinders are as 11 : 8 and their heights as 3 : 4 and if the base of the first has an area of 155 sq. ft., what is the area of the base of the second ?

**50.** A well 10 ft 6 in in diameter inside has a brick-work 1 ft. wide. If the water level is 20 ft. below the top and the water is 10 ft deep, find the cost of constructing the brick-work at 8 as per cub. ft below the water level and 4 as. above it. Answer to the nearest anna

**51** The weight of a cylindrical hollow leadpipe of external diameter 1 inch, and of length 1 ft. was found to be just half that of a solid lead cylinder of diameter  $\frac{3}{4}$  inch and length 6 inches Find the thickness of the hollow pipe to two places of decimals.

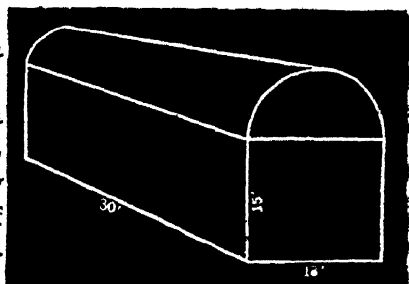
**52.** A cylindrical vat 4 ft high is to contain as much as twenty 36-gal. casks. Find the radius of the base given that 1 gal. weighs 10 lbs and that 1 cub. ft. of water weighs 1000 oz

**53.** Two pipes, one of lead and the other of tin, are respectively 49 in and 61.6 in long, they both have the same internal diameter, 1 inch. The external diameter of the lead pipe is 1.2 in.; if lead is 11 times and tin 7 times as heavy as water, what must be

the external diameter of the tin pipe so that both pipes may have the same weight ? (Answer to two places of decimals.)

54. Two cylindrical vessels are filled with water, the radius of one vessel is 6 inches and its height one foot, and the radius of the other is 8 inches, and its height 1 ft 6 in. Find the radius of a cylindrical vessel 11 inches in height which will just contain the water in the two vessels.

55. A hay-shed consists of a rectangular space 30 ft long, 15 ft high and 18 ft. wide with a semi-circular roof above it. Find, to the nearest integer, how many tons of hay can be stored in it, if a ton of hay occupies 300 cub ft.



56. The height of a litre cylinder is 14 in and its diameter 2.5 in. What will be the height of a cylinder holding 250 c. cm the diameter being 3 in ? (Answer to two places of decimals)

57. A cylindrical vessel of internal height 10 in. and radius 4 in. contains 3 in. of water. A lead cylinder 12 in high and 7 in. in diameter is placed in the vessel. Will the water overflow ? Examine the case when the lead cylinder is 9 in high.

58. If a strip of paper a mile long is rolled round a cylinder of wood half an inch thick, what will be the diameter of the resulting cylinder, supposing that 320 sheets of such paper has a thickness of one inch ?

59. A cylindrical boiler terminated by plane ends is internally 15 ft. long and 4 ft. in diameter and is traversed lengthwise by 50 cylindrical fire tubes, each 3 in. in diameter. Find the volume of water which the cylinder can contain.

60. A cylindrical pillar 8 ft high is made up of a cylindrical stone pillar surrounded by brick-work. If the circumference of the entire pillar be 22 ft. and the width of the brick-work  $1\frac{1}{2}$  ft., find, to the nearest rupee, the cost of raising the whole pillar at 8 as per cub. ft. of stone and  $1\frac{1}{2}$  as. per cub. ft. of brick.

61. A cistern 6 ft. long, 4 ft. wide and 2 ft. 6 in. deep is filled with pulp for making paper, which on drying shrinks to one-third of

its volume From it is produced a strip of paper 30 in. wide and 4 miles long, which is rolled into a solid cylinder. Find the thickness of the paper to three significant figures and the diameter of the roll to the nearest inch.

**62.** The wall of a circular room 12 ft. high is painted, the inside at 2 as and the outside at 4 as per sq. ft. If the total area painted be 5,544 sq ft and the total cost Rs. 1,056, find the thickness of the wall and the diameter of the room.

**63.** A teppakulam 100 yds. by 60 yds. has in its centre a square mantapam of side 25 ft. An engine pumps out the water which flows out from a pipe  $3\frac{1}{2}$  in. in diameter at the rate of 3 miles per hour How long will it take to sink the surface of the water in the tank by 1 ft.?

---

## EXERCISE XV.

### Pyramid

**1** Find the cubical contents of a right pyramid 8 in high which has an equilateral triangle of side 10 in. for its base.

**2.** A right pyramid stands on a regular hexagonal base whose side is 6 in The total area of the triangular faces is 800 sq in. What is the height of each face ?

**3** A tower whose ground-plan is a square on a side of 20 ft is furnished with a pyramidal roof 6 ft high Find the cost of covering the roof with sheet-lead at the rate of 8 as. per sq ft.

**4.** From a rectangular block of wood standing on a square base whose side is 1 ft, a pyramid is cut having the same base and height if the wood that is cut off weighs 140 lbs, find the height of the pyramid, given that 1 cub ft of the wood weighs 900 oz.

**5** A granite pillar, 5 ft high, having a square cross section on a side of 10 in is surmounted by a pyramid whose height is 1 ft. 9 in. Find the weight of the whole, if 1 cub ft of granite weighs 168 lbs

**6** A garden tent is in the shape of a cube surmounted by a pyramid If the edge of the cube is 12 ft. and the height of the central pole 20 ft, find (1) the amount of canvas used in making the tent and (2) the amount of air space in it.

**7.** How much metal is required to make a tray each side of whose base measures 10 in and each side of the top 12 in. the slant height being 2 in. ? Allow 4% extra for overlapping and wastage.

---

## EXERCISE XVI.

### Right Circular Cone ( $\pi = \frac{22}{7}$ )

1 A triangle ABC right angled at B is rotated about AB. If  $AC=11$  9 cm. &  $AB=10$ ·5 cm. find the volume of the solid generated.

2 The lateral height of a cone being 17 in. and the vertical height 8 in., find the diameter of the base.

3. The radius of the base of a cone is 21 in. and its height 28 in. Find its volume and the area of the curved surface.

4 Find, to the nearest square foot, the quantity of canvas required for a conical tent 12 ft. high which encloses an area of 154 sq. ft.

5 A conical vessel 15 in. deep and 14 in. in diameter across the top is held with its axis vertical, and vertex downwards. find (1) its capacity and (2) the weight of the vessel when empty, one sq. inch of the metal weighing 2 grams.

6. How many yards of canvas 27 in. wide will be required for a conical tent 7 ft. in radius and 9 ft. in height?

7. Find the volume of a cone the radius of whose base is 3 ft. 6 in. and whose height is one-fourth of the circumference of its base.

8. The volume of a cone 2 ft. high is 1,232 cub. in. Find the area of the curved surface.

9. What is the cost of polishing the curved surface of a solid cone whose diameter at the base is 12 ft. and slant height is 18 ft. 8 in. at 4 as per sq. foot?

10. Find the volume of a cone the circumference of whose base is 11 ft. and slant height 6 ft. 3 in.

11 A conical tent is to house 10 men each of whom must have 77 cub. ft. of air. If the height of the tent is to be 15 ft., find the area enclosed by the tent.

12. Find the height of a cone the radius of whose base is 1 ft. 6 in. and whose volume is equal to that of a cylinder of diameter 2 ft. and height 9 ft.

13 A cylindrical bucket filled with moist sand measures internally 12 in. in diameter and 10 in. in height. The bucket is emptied and a conical mound is built with the sand on a base whose diameter is 15 in. Find the height of the mound.

14. A solid cone of height 6 in. is immersed completely in water contained in a cylindrical vessel the diameter of whose base is 14 in. If the level of the water rises by  $\frac{1}{2}$  inch, find the radius of the base of the cone.

**15** A pencil 6 in. long has for its cross section a circle 35 in. in diameter. It is sharpened at one end into a cone of height 6 in. Find the volume of wood removed to three places of decimals.

**16.** The surveyor's staff 3'5 cm in diameter consists of a cylinder ending in a cone. The height of the staff is 2 metres and the slant height of the cone is 6.25 cm. Find the weight of the stick if 1 c. cm of wood weighs 6 gram.

**17.** A tent is in the form of a cylinder surmounted by a cone, the diameter of the cylindrical portion of the tent is 24 ft. The height from the ground to the vertex of the cone is 16 ft and the height of the cylindrical part 11 ft. Find the total area of canvas required for the tent.

**18.** A solid metal cone is placed inside a cylindrical vessel whose base is equal to that of the cone and water is poured in till the cone is just immersed. If the height of the cone is 7.2 in., find the depth of the water after the cone is removed.

**19** A granary full of grain is in the form of a cylinder surmounted by a cone, the greatest and the least heights of the granary being 19 ft. and 16 ft. If its greatest width is 14 ft., find the cost of paddy in it, if a bag of paddy occupying 8.25 cub. ft. costs Rs 7-8-0.

**20.** A cylindrical vase is 7 in. high and 4 in. in diameter, but a conical projection rises from the base which is 2 in. high and 3.5 in. in diameter. Find the capacity of the vase.

**21.** A cylindrical granite pillar 20 ft. high and 14 in. in diameter is surmounted by a cone 4 ft. in height, find the weight of the whole to the nearest cwt., if 1 cub. ft. of granite weighs 168 lbs.

**22.** From a cylinder 42 in. high and 56 in. in diameter a conical cavity of the same base and half its height is made. Find the volume and the whole surface area of the remaining solid.

**23** For measuring small quantities of oil an oil-monger uses a wooden measure which consists of a cylinder with a conical portion bored out. The cylinder is 4.5 in. high and 4 in. in diameter across the top. If the depth of the cone is 1.5 in., and the diameter of its base 3.5 in., find the capacity of the vessel, and the weight of the vessel. (1 cub. inch of wood weighs  $\frac{1}{8}$  oz.)

**24.** A conical vessel 1 ft. deep is 20 in. across the top. Find, to the nearest minute, how long it will take for a cylindrical pipe 1.5 in. in diameter to fill it, the rate of flow of water being 50 ft. per minute.

**25.** An aspirator consists of a cylinder 16 in. high and 8 in. in diameter terminating almost in cones at the two ends. If the cones are

4 in. high, find the quantity of water that it can hold. How long will it take to empty it, if the diameter of the outlet is 4 in. and the rate of flow is 80 ft<sup>3</sup> per minute? Find also the cost, to the nearest anna, of coating it with blue at 4 as. a sq. ft.

26. The height of a cone is 7 in. and its curved surface is 3 times the area of its base. Find the volume to 01 of a cub. in.

27. The height of a cone is 17 in. and its curved surface is 5 times the area of its base. Find, to the nearest hundredth of an inch, the radius of its base.

28. A cone whose vertical angle is  $90^\circ$  is 4 in. high. Find the whole surface and the volume.

29. The interior of a building is in the form of a cylinder of 15 ft. radius and 12 ft. altitude, surmounted by a cone whose vertical angle is a right angle. Find the area of the surface inside and the cubical contents of the building.

30. From a circular piece of paper of radius 7 in. a sector containing an angle of  $120^\circ$  is removed. It is folded so that the two bounding radii coincide. What is the solid formed and what is its height? If it is placed on the table, what portion of it will it enclose and how much air will be enclosed within it?

31. Find the corresponding results, if the other sector in the previous question is treated likewise.

## EXERCISE XVII.

### Partnership

1. A and B enter into a partnership. A puts in a capital of Rs. 200 and B Rs. 300. At the end of the year they gain Rs. 55. How should they divide the profit?

2. Three cowherds hired a pasture for Rs. 54. A sent 25 cows for 4 weeks, B, 18 for 5 weeks and C, 40 for 2 weeks. How much should each pay?

3. A began to trade with Rs. 300. After 4 months B joined him with Rs. 200. At the end of the year the profits amounted to Rs. 91. How much will each get?

4. A and B started a business with a capital of Rs. 6,000 of which Rs. 4,200 belonged to A. At the end of the year A got for his share Rs. 1,020 more than B. Find the profits of the year.

5. A began to trade with Rs. 1,200. After some months B joined him with Rs. 500. If the profits at the end of a year amounted to Rs. 795 and if B's share was Rs. 75, find when B joined A.

6. A began a business with Rs 4,500. Three months after, B joined A with Rs 1,500. Seven months after B joined A, the profits amounted to Rs. 720. How much more would B have got, if he had joined A at the very beginning?

7. Three persons contribute Rs. 500, Rs 1,000 and Rs. 1,500 towards a venture, on the understanding that the profits shall be divided in such a way that the rate of interest which each receives shall be in proportion to his contribution. If the profits for a year amount to Rs 490, how much will each receive?

8. A with Rs. 2,500 capital joins in partnership with B who has Rs 4,000 capital. At the end of a year they lose Rs 520 and their capitals are diminished accordingly. C now joins them with Rs. 4,500 capital. In the second year they gain Rs. 2,358. What does each receive?

9. A invests Rs. 1,500 and B Rs. 900 in a business. The gross receipts for the first year are Rs 560. Out of the profit 5% is paid for insurance and one-seventh for other expenses. Of the rest B receives a certain sum for managing the business and the remainder is divided between them in the ratio of their capitals. If A receives Rs 250, find B's salary as manager.

10. A and B enter into partnership with Rs. 3,000 and Rs 4,500. At the end of 8 months A advances Rs. 2,500 more. Seven months later they close the business with a profit of Rs. 1,040. How should this profit be divided?

11. A, B and C are partners in a business and each has a share of the profit in proportion to his capital. A's capital is Rs. 480 and his share is 15% of the profit. B's capital is Rs. 1,280. Find his share of the profit and C's capital.

12. A, B and C are partners in a business. At the beginning of a year each has Rs. 600 in the business. At the end of 6 months A adds Rs. 200 and B adds Rs 300, but at the end of 8 months C withdraws Rs 400 of his capital. If A gets Rs. 140 from the year's profit, what do B and C get?

13. A and B invest Rs 4,500 and Rs. 1,500 respectively in a business. Of the profit, B first receives 20% as manager. Interest is then paid on the capital at 4% per annum, the remaining profit being equally divided. In the year in which A receives Rs 280, what does B receive?

14. A and B engage in trade, their capitals being as 2 : 3. At the end of 4 months A withdraws one-fourth of his capital and B

withdraws one-third of his, but at the end of 7 months from the beginning B puts in three times the amount withdrawn by A. How should a profit of Rs 444 at the end of the year be divided?

### EXERCISE XVIII

#### Profit and Loss

1. A farmer bought 328 sheep at 27 s. 6 d. each and 48 lambs at 15 s. each 15 weeks afterwards he sold them at 39 s 3 d. and 22 s 9 d. each respectively. Meanwhile it took him on an average 6 d. each per week for feeding, and the other expenses amounted to 16 s 3 d. What was his net gain?

2. A man bought a flock of 248 sheep for Rs. 1,860. Six of them died and 20 others were found so sickly that he had to sell each of them at once for Re. 1 less than what he gave for it. At what price per head must he sell the remainder to gain Rs 180 by the transaction?

3. A person sold 84 measures of rice for Rs. 43—12—0 thus gaining 25% and 154 measures at a profit of 10%. If he had sold the whole at a profit of 16%, how much more would he have gained?

4. A merchant sells 49 quarters of corn at a profit of 7% and 84 quarters at a profit of 11%, if he had sold them all at a profit of 9%, he would have received £ 2—10—9 less than he actually did. What was the price he paid for the corn?

5. A merchant bought a quantity of coal and after selling it at 1 s. 6 d. per lb. he found that he had gained £ 4. Had he sold it at 1 s 4 d. per lb., he would have lost £ 6. Find the quantity of coal he bought.

6. A contractor bought 600 parabs of unslaked lime at Trichy at 14 as. per kalam, on slaking it, every parah gave  $3\frac{1}{2}$  cubic ft. of lime, but of this one-twelfth was unserviceable. The cost of carrying the remainder to Kulitalai (distant 22 miles) where it was required was 2 ps. per cub ft per mile. At what rate per cub ft must he sell it at Kulitalai to gain 20% on his outlay? 12 parabs = 5 kalamas

7. A sells goods to B at a profit of 12%. B sells the same to C at a profit of 25% on what they cost him and C sells them to D at a loss of 10% on what they cost him. If D pays Rs 65 more than what A pays for them, find the original cost of the goods.

8. A grocer mixes four kinds of tea worth 5 s., 4 s., 3 s. and 2 s. per lb. in the proportion of 2 3. 4. 7 respectively. At what rate must he sell the mixture so as to gain 25% on the whole?

9. A merchant buys wine at Rs. 6 a gal. and an inferior kind at Rs. 3—12—0 a gal. In what proportion must he mix them so that by selling the mixture at Rs. 5 a gal., he may gain 20% on his outlay.

10. A merchant received goods from England of which one-sixth was utterly spoiled, and one-third slightly damaged. He sold the remainder at double their cost price and the damaged goods at a loss of 25%. If he made a profit of Rs. 150, find his outlay.

11. I buy a certain number of copies of a book and by selling each copy for 12 as., I gain the cost price of 18 copies. If I reserve 8 copies and sell the rest, I would gain the cost price of 9 copies. How many copies do I buy?

12. A merchant buys a quantity of tea at an average rate of 12 as. 6 ps. per lb. He assorts the tea into three kinds which he sells at Re. 1—2 as., 14 as. and 9 as. per lb. respectively. If in the progress of assortment 25% of the tea is lost and if of what remains 36% is of the dearest kind and 24% of the cheapest, find the merchant's gain per cent. on the transaction.

13. A merchant marks his goods 20% above the cost price, but for cash sales allows a discount of 10% off the bill. Find the profit per cent. What is the cost price of an article bought for Rs. 6—12—0?

14. A mirasdar bought two cows for the same price. He sold the first to A at a gain of 16% and the second to B at a loss of 4%. If B sold his cow for the price paid by A to the first, find his gain per cent.

15. A milkman had two cows. By selling the first for Rs. 75 he gained one-fifth of its cost price. He sold the second at a loss of 5%. If he gained 11% on the whole, find the cost price of the second cow.

16. Biscuits which cost 6 as. per lb. to a baker were sold at 10 as. per packet. The cost of manufacture has risen 10% and yet each packet is sold only for 10 as. But each packet now weighs 15 oz. instead of 1 lb. Find the baker's profit in the second case.

17. A merchant buys in Madras 210 bags of rice at Rs. 20—12—0 per bag of 150 lbs. He sends them by rail 256 miles at  $6\frac{1}{2}$  pies per ton per mile, but during the journey  $4\frac{1}{2}$  lbs. are stolen from each bag. Find at how many measures per rupee he must sell the remainder in order to clear Rs. 430 by the transaction. (One measure =  $3\frac{1}{2}$  lbs.)

18. A merchant wishing to clear out his old stock sells one lot of goods at a reduction of 10%, another at a reduction of 25%, and a third at a reduction of 50% on the usual prices. He realises Rs. 540, Rs. 645 and Rs. 375 for these lots respectively and finds that on

the whole he has a loss of  $2\frac{1}{2}\%$  on the price paid by him for the goods. What per cent. would he have gained if he had sold the goods at the usual rate

**19.** Ice is manufactured at  $2\frac{1}{2}$  pies per lb. and sold at 6 pies per lb. Of the total quantity made one half is kept for sale at the factory and the remainder sent to branch shops. The loss from melting is  $12\frac{1}{2}\%$  in the case of the former and 25% in the case of the latter and the agents at the branch shops receive commission at the rate of 15% on the selling price of every lb sold by them. Find the profit on every ton of ice manufactured

**20.** A merchant bought 60 measures of castor oil at Re 1—2 as a measure and purified it at a cost of 2 as per measure. During the process 5% of the oil was lost and the rest was bottled at a cost of Re 1 per dozen bottles. If the marked price of a bottle was 12 as. and a discount of  $12\frac{1}{2}\%$  was given for whole sale dealers, find the merchant's gain, if he sold one-fourth of the quantity in retail and the rest whole-sale. (1 measure = 4 bottles)

**21.** A coffee merchant in India buys coffee for shipment to England, for which he pays on the average Rs 11—15—3 per maund of 25 lbs. The process of curing reduces the weight of coffee by 10%, and for carriage, curing, and freight he has to pay Rs 60 per ton of cured coffee. If the coffee is sold in England at the rate of 92 s 6 d. per cwt. and if the amount realised from the sale is remitted when exchange is 1 s 4 d per rupee, find the merchant's gain per cent. on his outlay.

**22** A publisher brings out at a cost of Rs. 1,500 an edition of 750 copies of a book and agrees to give the author 60% of the profits. He gives away 100 copies as presentation copies and sells the rest to a bookseller for whom he allows a discount of 25% of the marked price and counts 13 copies as 12. If the publisher's profit is Rs. 300, find the selling price of the book and the gain per cent. of the bookseller.

**23.** A merchant sells silk of two qualities which cost him Rs. 5-5-4 and Rs. 4-4-4 per yard respectively. The selling price of the latter is two-thirds of the former, but the quantity sold is double and the merchant gains 25% on the whole. Calculate the selling price per yard of each.

**24.** A barterers sugar with B for paddy which is worth  $1\frac{7}{8}$  as a measure. But in weighing his sugar, he uses a false maund weight. B discovers this and to make the exchange fair, raises the price of his

paddy to  $2\frac{1}{2}$  as. a measure. Find the real weight of the false maund which A uses.

## EXERCISE XIX.

### Time and Work

1. Rama can do a piece of work in 3 days, while Govind can do it in 6 days. In what time can they do it together?

2. A pipe P can fill a tub in 24 minutes and another pipe Q can fill it in 30 minutes. In how many minutes can they both fill it?

3. A can do a piece of work in 8 days of 5 hours each, while B can do it in 3 days of 8 hours each. In how many days of 6 hours each can A and B do it together?

4. John takes 6 days to do  $\frac{1}{3}$  of a work, while David takes 3 days to do  $\frac{1}{4}$  of the work. What time will both of them take to do it together?

5. A does in 2 hours what B does in 3 hours. If A alone can do a work in 40 hours, in how many hours can A and B do it together?

6. A's wages are 12 annas a day and those of B are 8 annas a day. A certain work will cost Rs. 9 if A is employed and Rs. 10 if B is employed. What will it cost if both A and B are employed?

7. A and B can do a work in 12 days, while B alone can do it in 20 days. In what time can A alone do it?

8. Two taps P and Q can fill a cistern in 15 minutes. If P alone can fill it in 24 minutes, how soon will Q alone fill it?

9. A pipe can fill a cistern in 5 minutes, while an outlet can empty it in 15 minutes. The cistern is empty and both are kept open. When will the cistern be half full?

10. A cistern has a filling pipe as well as a waste pipe to empty it. If both are open, the cistern will be full in 40 minutes. If the waste pipe is closed, it will be filled in 8 minutes. How long will it take for the waste pipe to empty it when full?

11. There is a hole at the bottom of a tub. If the tub were in good condition, it would be filled in 40 minutes. It now takes 20 minutes longer. In what time will the tub which is full become empty, if the filling pipe is then closed?

12. A can copy a certain manuscript in 12 hours at the rate of 3 lines per minute. B can copy the same in 18 hours. A begins the work, copies 480 lines and leaves off. In what time can B finish it?

**13** A can do a piece of work in 12 days. After working for 8 days he leaves off. If B completes the work in 5 days, how long will A and B take to do it together?

**14.** A man does twice as much work as a boy. 10 men and 12 boys can bridge a channel in 30 days. How many boys should assist 20 men if the work is to be completed in 12 days?

**15.** A, B and C take 8 days to do a work. But A and B will do it in 12 days, while A alone can do it in 18 days. In what time can B and C do it separately?

**16** 25 men can reap  $3\frac{1}{2}$  acres in 14 hours, while 20 women can reap  $1\frac{1}{2}$  acres in 9 hours. In how many hours can 30 men and 24 women reap  $7\frac{1}{2}$  acres?

**17.** A can do a piece of work in 12 days, B in 16 days, and C in 18 days. They all begin together, but after 2 days B leaves off and after 6 days (from the beginning) C leaves off. In how many days will the work be finished?

**18** A can do a piece of work in 16 days, B in 12 days, and C in 9 days. They all begin together, but C leaves off after 3 days. If A goes away one day before the work is finished, how long does the work last?

**19.** A and B dig a pit in 6 hours while B and C do the same in 4 hours. If A, B and C can finish it together in 3 hours, how long will it take them to do it separately?

**20.** A and B can do in 20 hours a work which A alone can do in 36 hours. They undertake to do a work for Rs. 9—6, which, with the help of a boy, they do in 18 hours. How should the money be divided?

**21.** 120 men and 180 women can raise an embankment 480 ft. long in 40 days. In how many days will 76 men and 240 boys raise an embankment 360 ft. in length and of the same cross section, supposing the work done by a man, a woman, and a boy to be in the ratio of 5 : 4 : 3?

**22** 300 coolies were employed to build a tank bund. At the end of 10 weeks only half the work was done, when the work had to be stopped for 3 weeks on account of rain which washed away  $\frac{1}{10}$  of the work done. Then the work was resumed with only 200 coolies. In what time from the commencement was the work finished?

**23.** A contractor engages 40 men and 64 women for 13 weeks over a work for which he pays Rs. 4,836 as wages. How long will it take 50 men and 72 women to do the work and what will the total

wages amount to ? 3 men can do as much work as 4 women and the wages of 2 men are equal to those of 3 women

**24** 40 men are engaged to dig a tank 80 ft. long, 70 ft. broad and 8 feet deep. They work for 12 days and have just completed three-fourths of the work, when it is resolved to increase the length of the tank by 20 ft., the breadth by 10 ft. and the depth by 2 ft. How many additional men must be employed so that the work may be finished in 10 days more ?

**25** P and Q are two pipes which can fill a cistern in 15 and  $12\frac{1}{2}$  minutes respectively. Both pipes are opened. Find when the second must be closed so that the cistern may be just filled in 9 minutes

**26.** A tub is filled by a hot water pipe A and a cold water pipe B and is emptied by a waste pipe C. If A, B and C are kept open, the tub will be full in 24 minutes. If C is kept closed, the tub will be full in 6 minutes. If B alone can fill it in 18 minutes, find the time taken by A to fill the tub, and by C to empty it.

**27.** A hot water pipe can fill a bath in  $7\frac{1}{2}$  minutes and a cold water pipe in 5 minutes. A gentleman opened the two taps at the same time and returned at the instant when the bath should be full. Finding, however, that it was only three-fourths full, he closed the waste pipe. Find in how many minutes more the bath would be full and how soon the waste pipe could empty the bath

**28.** A bath has a cold water pipe and a hot water pipe. A person opens the two pipes simultaneously and returns at the end of 6 minutes expecting the bath to be full. Finding, however, that it is only half full, he now closes the waste pipe. The bath becomes full in another 3 minutes. If the cold water pipe alone can fill it in 10 minutes, find the time taken by the hot water pipe to fill the bath and by the waste pipe to empty it

**29.** A pipe A can fill a cistern which has a hole at the bottom in 25 minutes, while another pipe B ~~in~~  $37\frac{1}{2}$  minutes. If both the taps are opened, the cistern will be full in 12 minutes. Find how long it will take the cistern to empty itself by leaking.

**30.** A reservoir which is full and has a constant supply of water has a certain number of outlets of equal cross section at the bottom. If 12 outlets are opened, the reservoir will be emptied in 400 minutes. If 20 outlets are opened, it will be emptied in 80 minutes. If 15 outlets are opened, find the time when the reservoir will be empty

---

## EXERCISE XX. Symbolical Expression Part II.

1. A & B travel along the same road in the same direction at  $a$  and  $b$  miles an hour respectively. When A is at a point O, B is  $m$  miles ahead. If B is overtaken  $h$  hours later at a place  $n$  miles from O, find  $h$  and  $n$  in terms of  $a$ ,  $b$  and  $m$ . Also give the values of  $h$  and  $n$  when  $a=6$ ,  $b=3$  and  $m=9$ .

2. A cyclist can travel  $q$  miles an hour on a still day, but his speed is decreased  $m$  miles an hour against a certain wind, and increased  $n$  miles an hour with this wind. How long would it take him to go  $d$  miles and to return, going with the wind and returning against it? Give the time to the nearest hour when  $q=9$ ,  $m=3$ ,  $n=2$  and  $d=27$ .

3. P and Q are two brickstacks  $a$  miles apart, the price of bricks at P is Rs.  $p$  a thousand and at Q it is Rs.  $q$  a thousand, the cost of carriage from each stack is Rs.  $r$  per hundred per mile. Give in terms of  $p$ ,  $q$  and  $r$ , the distance from P of a point  $\lambda$  on the road from P to Q at which the total cost of the bricks is the same whether they come from P or Q. Give the numerical result when  $p=5$ ,  $q=6$ ,  $r=\frac{1}{2}$  and  $a=20$ .

4. A pint of milk weighs  $a$  lbs. and a pint of water,  $b$  lbs. and a pint of the mixture of the two weighs  $c$  lbs. What fraction of the volume of the mixture is milk? If  $a=1.128$ ,  $b=1.125$  and  $c=1.127$ , what fraction is milk?

5. A man travelled a distance of  $d$  miles partly by rail and partly by coach at a total cost of Rs.  $t$ . If he travelled  $m$  miles by rail at a cost of  $r$  as. per mile, find the cost of travelling one mile by coach.

6. The marked price of an article was Rs.  $m$ . A discount of  $d\%$  off the marked price was given for cash payments. If the cost price of the article was Rs.  $c$  and the gain per cent.  $g$ , find a relation connecting  $m$ ,  $d$ ,  $g$  and  $c$ .

7. The salary of a railway clerk was first increased by  $a\%$  on account of famine. His new salary was further increased by  $b\%$ . If his original salary be Rs.  $x$ , and his final salary Rs.  $y$ , express  $y$  in terms of  $a$ ,  $b$  and  $x$ .

8. A publisher sold his books to a wholesale dealer at a gain of  $a\%$  who sold them to a retail dealer at a gain of  $b\%$ . If the retail dealer made a profit of  $c\%$  by selling a copy for Rs.  $d$ , what did a book cost to the publisher?

9. A sold a horse to B at a gain of  $p\%$ . B sold it to C at a loss of  $q\%$  on what it cost him. If C sold it to a customer for Rs.  $z$  and gained Rs.  $y$ , find a relation connecting  $p$ ,  $q$ ,  $z$ ,  $y$  and  $x$ , where Rs.  $x$  is the cost of the horse to A.

**10** A certain sum of money would pay A's wages for  $a$  days, B's wages for  $b$  days or C's wages for  $c$  days. How long will the money last if A, B and C are employed together?

**11** Water enters a tank by a tap A which can fill it in  $a$  hours and leaves it by two taps B and C which can empty it in  $b$  and  $c$  hours respectively. (1) If the cistern is empty, and the taps A and B are turned on, how soon will it be full? (2) If the cistern is full and all the three taps are turned on, how soon will it be emptied? Also give the numerical result when  $a=3$ ,  $b=4$  and  $c=6$ .

**12.** At present A's age is  $a$  years and B's age is  $b$  years. How many years ago was A's age three times B's age? Evaluate the result when  $a=70$  and  $b=30$ .

**13.** A is now  $q$  times as old as B and  $a$  years ago he was  $p$  times as old as B. What are their ages now? Find A's age when  $a=8$ ,  $p=6$  and  $q=4$ .

**14.** A's age is  $x$  years and B's  $y$  years.  $a$  years hence A's age will be the same as B's was  $b$  years ago. Find  $y$  in terms of  $a$ ,  $b$  and  $x$ . Evaluate the result when  $a=7$ ,  $b=8$  and  $x=12$ .

**15** Brine is formed by dissolving  $p$  grams of salt in  $q$  cub. cm. of water. How many grams of salt are there in  $r$  grams of brine, 1 gram of water occupying 1 cub. cm.?

**16.** If  $a$  men can earn Rs.  $b$  in  $c$  days, in how many days will  $p$  men earn Rs.  $q$ ?

**17.** The cost price of an article is Rs.  $a$ . What should be the marked price of the article so that the merchant may gain  $g\%$  after allowing a discount of  $d\%$ ?

**18.** A garden  $l$  ft by  $w$  ft has a path  $p$  ft wide all round it on the inside. Find the cost in rupees of gravelling it with gravel inches deep at  $c$  as. a cub. foot.

**19.** A rectangular sheet of paper is found to be  $a$  cm. long and  $b$  cm. broad and its area is calculated therefrom. If each of the above measurements is  $x$  cm. less than it should be, find the error in the calculated area. Give the numerical result to the nearest integer for the case in which  $a=33$ ,  $b=20$  and  $x=0.5$ .

**20.** A certain alloy is composed of tin and copper in the ratio of  $x$  to  $y$ . Find the value in £ of  $z$  oz. of the alloy, if the price of tin is  $a$  shillings per lb. and of copper  $b$  shillings per lb.

**21.** Two men rent a field of grass for Rs.  $p$ . The first turns cattle into the field for  $a$  days, while the second turns  $y$  cattle into

the field for  $b$  days Find how much each should contribute to the rent, if they pay in proportion to the use they have had of the field.

**22.** A began to trade with a capital of Rs.  $a$ . After  $m$  months B joined him with a capital of Rs.  $b$ . At the end of the year the profits amounted to Rs.  $p$ . If their shares of the profits are Rs.  $x$  and Rs.  $y$ , express  $x$  and  $y$  in terms of  $a$ ,  $b$ ,  $p$  and  $m$ .

**23.** A is to pay twice as much as B towards the upkeep of a joint establishment. A and B respectively pay £  $a$  and £  $b$  towards the expenses, B lends £  $c$  to A and in settlement of their accounts A pays £  $x$  to B. Find  $x$  in terms of  $a$ ,  $b$  and  $c$ . If  $a = 120$ ,  $b = 150$  and  $c = 50$ , find the value of  $x$  and evaluate the result.

**24.** During a tour A and B pay respectively £  $a$  and £  $b$  towards the common expenses. In order to share the expenses equally A pays £  $x$  to B. Write down an equation connecting  $x$ ,  $a$  and  $b$ . If the total expenses of the tour is £66 and if A pays £10 to B, what are the values of  $a$  and  $b$ ?

**25.** A room is  $l$  ft. long and  $b$  ft. broad and the walls are  $t$  inches thick. It has a verandah  $v$  feet wide all round it. Find the number of slabs each  $c$  in. by  $d$  in. required for paving the verandah.

**26.** Two circular discs whose diameters are  $a$  and  $b$  inches are melted and are recast into a single circular disc of the same thickness as each of the former. If its diameter is  $c$  inches, find a relation connecting  $a$ ,  $b$  and  $c$ .

## EXERCISE XXI.

### Graphs.

#### A.—STATISTICAL.

**1.** The following table gives the number of successful candidates for honours in the Mathematical Tripos at Cambridge —

Year ..	1820	1830	1840	1850	1860	1870	1880	1890	1900
Number..	52	98	147	122	121	115	99	105	82

Represent this graphically.

**2.** The following table gives the value of imports in millions of into the United Kingdom from 1900 to 1906 :—

Year ..	1900	1901	1902	1903	1904	1905	1906
Value of imports.	523	522	528	543	551	565	608

Exhibit this graphically.

**3.** The maximum and minimum shade temperature in degrees Fahr., as recorded at Madras on seven consecutive days are given by

the following table —

Day	1	2	3	4	5	6	7
Max temp.	89.2	87.3	85.3	84.3	86.3	88.4	86.3
Min. temp.	76.4	76.4	72.7	74.9	75.6	75.3	73.9

Exhibit the above graphically on the same page.

4 The following table shows how the speed of a train increases

Time in seconds from start.	0	4	8	12	16	20	24
Velocity in feet per second.	0	1.4	3.6	6.3	9.4	12.4	13

Exhibit this graphically and find the speed at the 10th second

5. The following table gives the angle in degrees between the arms of a pair of compasses each 1 foot in length and the distance in feet between the two ends —

Angle	..	10	20	40	50	60	80	90	100	120
Distance	..	17	35	68	85	1.0	1.29	1.41	1.53	1.73

Represent this graphically.

6. The following is an extract from a trade catalogue —

Saucepans —	1	2	3	5	7	10
Capacity in pints.						
Price in Rs.	1.14	2.8	3.2	3.12	5.0	7.8

Exhibit this graphically and from it find the prices of saucepans containing 4 pints and 9 pints.

7 The temperature,  $^{\circ}\text{C}$ , at the depth D metres below the surface of the ground, is as follows —

D	6	37	68	99	130	161	192	223	254	285
T	12.1	13.1	14.3	14.6	15.6	16.0	16.5	17.3	18.1	18.9

Plot the points and from the graph find the temperature at a depth of 75 metres

8. The heights of an individual at different ages are given by the table —

Age in years	2	4	10	12	14	17	20	35
Height in inches ..	34	40	50	55	61	68	68½	68½

Draw a graph showing the growth of the individual, and find his probable height at—(i) 9 years, and (ii) 24 years of age

9. Draw a smooth curve to represent the variations in the height of the barometer, H inches

Time..	3 a.m.	6 a.m.	9 a.m.	12 noon	3 p.m.	6 p.m.	9 p.m.	12 night
H	29.87	29.90	30.01	29.96	29.91	29.94	29.98	29.94

**10** Annual premiums payable during the whole of life for an assurance of Rs. 1,000 payable at death are given below —

Age	20	22	25	30	35	38	40
Premium (Rs)	19.7	20.4	21.9	24.6	27.15	30.10	32.11

Draw the graph and find from it the premium for 32 yrs. and 28 yrs.

**11** The average maximum shade temperature in degrees Fahr. at Trichinopoly during the 12 months beginning with January is 88, 92, 97, 102, 99, 97, 96, 94, 91, 91, 87 and 87. Exhibit this graphically.

**12.** The time of sunrise and sunset at Trichinopoly on the 1st of every month beginning with January is given below

Sunrise	6.35	6.39	6.30	6.10	5.53	5.45	5.50	5.57	6.1	6.2	6.6	6.19
Sunset	5.50	6.6	6.14	6.17	6.20	6.28	6.35	6.33	6.17	5.53	5.40	5.37

Exhibit graphically the length of day in the different months and find the date when the day is longest.

**13.** The following table gives the expectation of life for different ages in years.

Age	10	15	20	25	30	35	40	45	50
Expectation	50	45	41	37	33	29	26	22	19

Draw a graph and hence find the expectation of life at the 27th year.

**14** The following table gives the corresponding values of the length and breadth of rectangles of the same area (64 sq. ft.)

Length	.	2	4	6	7	10	12	16	20
Breadth	.	32	16	10.7	9.1	6.4	5.3	4	3.2

Represent this graphically

**15.** On a contour map are two places P and Q 5 miles apart. The heights above sea level of points in the line between them and distant 0, 0.1, 0.7, 2, 2.2, 2.7, 3, 4, 4.7 and 4.9 miles from A are 788, 700, 500, 400, 400, 500, 600, 600, 400 and 300 ft. respectively. Show by a diagram the lie of land between A & B.

**16.** ABCD is a square sheet of paper fixed on to a drawing board. A ruler is placed at the end A and is rolled across the paper at right angles to AC. The distances of the ruler from A measured along AC and the area rolled over are given in the following table —

Distance in cm.	2	3	5	7	9	10	11	14	18	19
Area in sq. cm.	4	9	25	49	81	100	119	164	196	199

Represent this graphically.

**17.** In the following table  $l$  stands for the length of a pendulum in centimetres and  $t$  for the time of a complete oscillation in seconds.

$l$	.	45	50	55	60	65	70	75
$t$	.	1.34	1.41	1.48	1.55	1.61	1.67	1.73

Exhibit this graphically and find  $t$  when  $l = 1.5$  and  $t$  when  $l = 68$

### B.—READY RECKONERS.

1. Given that a sovereign is equal to Rs. 15, draw a graph for the conversion of rupees into pounds and *vice versa*. Read off the value of Rs. 50 in pounds and of £  $5\frac{1}{4}$  in rupees

2. If 1 in. is equal to 2.5 cm. draw a graph for expressing inches in centimetres and *vice versa*. Find the equivalent in centimetres, of 4.6 in. and in inches of 6.7 cm.

3. If 1 cub. ft = 6.25 gallons, draw a graph to convert cubic feet into gallons. Read off the number of gallons in 93 cubic feet and the number of cubic feet in 615 gallons

4. If a speed of 30 miles per hour is equal to 44 ft per second, find graphically the number of feet per second corresponding to a velocity of 17 miles per hour

5. The expenses of a boarding house are partly constant and partly proportional to the number of boys. The expenses were Rs. 370 for 25 boys and Rs. 440 for 32 boys. Draw the graph to represent the expenses for any number of boys. Find the expenses for 15 boys and the number of boys that can be maintained for Rs. 230

6. The cost of a gramophone with 12 plates is Rs. 80 and with 18 plates is Rs. 95. Find graphically the cost of the machine and its cost with four plates

7. The highest and the lowest marks in an examination are 82 and 6. They have to be raised so that they become 95 and 18 respectively. Draw a graph from which the raised marks can be read off and from it find the new marks for 32 and 47

8. In a tennis court every member has to pay a monthly subscription and an extra amount for every set that he plays and  $x$  and  $y$  stand for the number of sets played and the total amount paid in annas. When  $x = 40$ ,  $y = 28$ , and  $x = 24$  when  $y = 20$ . Draw the graph supposing  $x$  to range from 5 to 50.

9. The salary of an officer is increased each year by a fixed sum. After 8 years' service his salary is Rs. 115 and after 17 years' service, Rs. 160. Draw a graph from which his salary may be read off for any year and find from it (1) his initial salary and (2) the salary he should receive for his twenty-seventh year

### C.—LINEAR EQUATIONS

1. Plot the following points and say how they arrange themselves.  $(7, -2), (+3, +5), (-3, -1), (0, -5), (-2, 0), (+5, -3), (-7, -2)$ .

2. Plot on different pages the following sets of points —

(a)  $(+2, +4), (+1, +2), (-3, -6), (-4, -8)$  &  $(-12, -24)$ .

(b)  $(-2, +6), (+4, -12), (+7, -21), (-9, +27)$  &  $(+11, -33)$

(c)  $(+8, -2), (-12, +3), (+4, -1), (+32, -8)$  &  $(-20, +5)$

(d)  $(+2, +5), (+5, +11), (+7, +15), (+8, +17)$  &  $(-3, -5)$

How do the points lie in each case? What is the relation that you note between the co-ordinates of the points in each set? Mention some points which will satisfy the different relations. Draw the line passing through the points in each set and see if it passes through the points mentioned by you

3 Write down the co-ordinates of some six points which will satisfy each of the following equations.

$x = 5y, y = 3x - 1, y = 5 - 2x, 2y = 3x + 2, 3x - 2y + 7 = 0, y - 3x = 7$ . Plot them on separate pages and draw the straight line passing through each set. What is the least number of points that should be plotted in each case to draw the graph of the given equation?

4. On the same page and with the same scale draw the graphs of  $y = 2x, y = 2x - 3, y = 2x + 7, 2y = 4x - 3, 6x - 3y = 11$ . State any peculiarity you note and mention some equation whose graphs will have the same property.

5. On the same page and with the same scale draw the graphs of  $2y + x = 3, 3y + 2x = 2, 5x + 3y + 13 = 0$ . State the peculiarity that you note.

6 Find the area of the triangle the equations to whose sides are  $2y + x = 9, x = 3y + 4, x = 25$

7 Solve graphically and check algebraically —

(a)  $2x + y = 11; 3y - 4x = 8$ .

(b)  $x - 5y + 7 = 0; 2x + 3y = 12$

(c)  $\frac{x}{5} + \frac{y}{2} = 2, \frac{x}{2} - \frac{y}{4} + 7 = 0$ .

(d)  $1\frac{1}{2}x - y = 0, \frac{y}{4} + \frac{y}{5} + 1 = 0$ .

(e)  $4x + 6y = 0, 15x - 5y = 33$

(f)  $2y - x + 2 = 0, y = 6$ .

(g)  $3x + 4y = 0, x = 8$ .

*For questions in the graphical solutions of simultaneous equations and problems refer to Ex V a and b.*

#### D.—TIME AND DISTANCE.

1. A leaves P for Q (distance 20 miles) at 6 A. M. and travels at 4 miles per hour Find graphically (1) when he will arrive at Q, (2)

where he will be at 10-45 A. M. and (3) when he will be 14 miles from P.

2 Tom and Jones leave P and Q 60 miles apart at the same time and travel in opposite directions. If their rates of walking are 3 miles and 5 miles an hour, find (1) the time and place of their meeting and (2) the time when they will be 10 miles apart.

3 A dog runs in pursuit of a hare 60 yds in front of him. If their speed be 12 yds. per second and 10 yds per second, find when and where the hare will be caught.

4 A thief leaves Trichy at 5-30 A. M. and runs at 8 miles an hour, a constable from Trichy starts in pursuit of him at 6 A. M. and travels at 10 miles an hour. Find graphically (1) when and where the thief will be caught (2) the distance between them at 7 A. M. and (3) when they will be 3 miles apart.

5 Paul starts from Pudukottah, 32 miles from Trichy, at 5 A. M. and travels at 5 miles an hour. Jacob leaves Trichy for Pudukottah at 6 A. M. and meets Paul at a place 14 miles from Trichy. Find graphically the time of Jacob's arrival at Pudukottah and his rate of walking.

6 A mail train leaves P for Q (60 miles) at 8 P. M. and runs at 30 miles per hour. Subsequently a goods train leaves Q for P, meets the mail train at 9-35 P. M. and arrives at P at 2-20 A. M. Find the time when the goods train left Q.

7. A starts at 5 A. M. walking at 4 miles per hour. B follows in the same direction at 5-30 A. M. at 5 miles per hour, then C rides in pursuit starting at 6-45 A. M. at 8 miles an hour. When does B catch A, C catch A and C catch B?

8 A cyclist started at 7 A. M. and travelled at 8 miles per hour resting for quarter of an hour after every two hours of cycling. A motorist starting from the same place at 10-12 A. M. travelled in the same direction at a uniform rate of 16 miles per hour. When and where did the motorist overtake the cyclist?

9 A left P for Q (distance 40 miles) at noon and travelled at 5 miles per hour. After reaching S, 25 miles from P, he turned back and went to C (15 miles from P), where he stayed for an hour. He then continued his journey at 6 miles an hour. Find graphically when and where he would have met the motorist who left Q for P at 6 P. M. and travelled at 10 miles an hour.

10 A train generally runs 75 miles with uniform speed in 3 hours without stopping. One day the engine gets derailed at the 60th mile from the starting place and is only able to proceed subsequently

on its journey at half its usual speed. It arrives one hour and 12 minutes late. How long was it delayed at the 60th mile?

**11** A cyclist left T for M (21 miles) at 7 A.M. and travelled at 8 miles an hour. He reached a village 19 miles from T and returned back. After travelling a certain distance he continued his journey to M which he reached at 11-15 A.M. If the rate of cycling was uniform throughout, exhibit his journey graphically

**12** A man has to walk a certain distance in 6 hours. He walks for  $3\frac{1}{2}$  hours at 5 miles an hour and then rests for half an hour and just completes his journey at the same rate in time. Exhibit his journey graphically and find when he was 2 miles from his destination

**13.** A man walks from X to Y and travels at 4 miles an hour for the first  $1\frac{1}{2}$  hours, at 5 miles an hour for the next 2 hours and at 4 miles an hour for the next 1 hour. A cyclist leaves Y for X at the same time and travels the first ten miles at 8 miles per hour, the next eight miles at 7 miles per hour and the remaining distance at 6 miles per hour. Find graphically when and where they will meet

**14.** The distance from P to Q along a road is 65 miles. A person A starts from P at 7 A.M. and travels to Q on his motor-cycle at the rate of 10 miles an hour, taking rest for 10 minutes at the end of every hour of cycling. B starts from P at 8-45 A.M. and goes to Q on his motor-car at a uniform rate of 15 miles an hour. Represent their journeys graphically.

Find from the graph (1) when each of them will reach Q, (2) when and where B will overtake A, and (3) by what distance they will be apart at 9-15 A.M. (S. S. L. C 1919.)

**15** A and B leave M for P at the same time, A walking at the rate of 5 miles an hour and B at the rate of  $3\frac{1}{2}$  miles an hour. A on reaching P retraces his steps and meets B at a place 30 miles distant from P. Find the distance from M to P.

**16** The following is an extract from the S. I. R. Guide —

No-71. Passenger.	Miles from Beach	Stations.	No. 22. Passenger
H M			H. M.
8—30	252	D Trichy Junction	A 13—45
8—43	255	A Trichy Fort	D 13—30
8—58		D	A 13—25
9—39	264	Elamanur	
10—30	275	Kulitalai	Read up 12—32
10—54	281	Lalapet	11—34
11—22	288	Kattalai	10—58
12—0			10—22
12—10	299	A Karur	D 9—37
		D	A 9—27
14—55	339	A Erode	D 6—35

Draw the graph representing the running of the two trains

## EXERCISE XXII

## Practical Geometry

## TRIANGLES

1. A and B are two points 26 inches apart. Find a point C 1'8 inches from A and 2'3 inches from B. Draw the triangle ABC and find its area.

2. Construct a triangle ABC given that

(a)  $BC = 5.6 \text{ cm.}$ ,  $\angle B = 72^\circ$ ,  $BA = 4.7 \text{ cm.}$

(b)  $AB = 2.8 \text{ in.}$ ;  $\angle B = 65^\circ$ ,  $\angle C = 57^\circ$

(c)  $BC = 5 \text{ cm}$ ,  $\angle C = 48^\circ$ ,  $AB = 6.4 \text{ cm.}$

(d)  $a = 1.5 \text{ in}$ ,  $\angle A = 27^\circ$ ,  $\angle C = 19^\circ$

(e)  $b = 7 \text{ cm.}$ ,  $c = 3 \text{ cm}$ ,  $\angle B = 135^\circ$

Measure the remaining angles and sides and find the area in each case.

3. Two forts A and B are situated at a distance of  $4\frac{1}{2}$  miles. A has guns which carry 3 miles and B has guns which carry  $3\frac{1}{2}$  miles. Show by a diagram the area commanded by both the forts.

4. The sides of a triangular field are 200 yds., 240 yds., and 260 yds., in length. Draw a plan to scale and find its area.

5. A and B are two points 2 miles apart on a straight road and C is the foot of a vertical flagstaff. The angles BAC and ABC are found to be  $45^\circ$  and  $70^\circ$  respectively. Draw a figure and find the shortest distance from C to the road.

6. A and B are two points on one bank of a straight river distant from each other by 600 yds. C is a point on the opposite bank and the angles CBA and CAB are respectively  $45^\circ$  and  $78^\circ$ . Find by drawing and measurement the width of the river.

7. ABC is a garden in which AB runs north and AC runs north east. If AB and AC are 120 yds and 160 yds. long, draw a plan of the garden and find its area.

8. ABC is a garden in which AB runs west and BC runs north-east. If AB and AC are 70 yds and 130 yds long, find by means of a figure the area of the garden.

9. When viewed from a ship a light house  $L^1$  is 5 miles off towards the north-west and another light-house  $L^2$  is 7 miles off towards the south-west. Find the distance between the light-houses and in what direction  $L^2$  is to  $L^1$ .

10. A ship noticed a light house in a direction  $25^\circ$  to the west of north. It sailed 4.5 miles west and found the light house exactly north. Find the distance of the ship from the light house in the second position.

11. A man walking along a straight road which runs due east observes that at a certain point the bearing of a light house is  $50^\circ$  east of north. After he has walked 2 miles from that point, the bearing is  $20^\circ$  east of north. Draw a figure to scale and find by measurement the distance of the observer from the light-house in each position. Also find how much further he must walk along the road in order to come to the point on the road nearest to the light house

12. A, B and C are three villages B is 4.5 miles from A in direction  $40^\circ$  north of east C is 5.2 miles from A in direction  $32^\circ$  north of west. Determine as accurately as you can the distance and bearing of C as seen from B.

13. A man travels 5 miles from A in direction  $20^\circ$  north of east to B and thence 4 miles in direction  $40^\circ$  north of east to C. By drawing and measurement find the distance direct from A to C and the angle which AC makes with the easterly direction.

14. The angle of elevation of a tower from a place 50 feet from its foot is  $35^\circ$ . Draw a figure and find its height.

15. From the top of a tree 120 ft high, a man sees a gold coin lying on the floor. If the angle of depression is  $42^\circ$ , find geometrically the distance of the coin from the foot of the tree.

16. At a distance of 45 yds. from the foot of a tower, the angle of elevation of its top is  $22^\circ$ , while the angle subtended at the same point by the flagstaff at the top of the tower is  $10^\circ$ . Find the height of the tower and the length of the flagstaff.

*In an isosceles triangle the angles opposite to the equal sides are equal.* Verify this experimentally.

17. On a base of 2 inches construct an isosceles triangle each of the equal sides being 2.8 inches and find its area

18. Construct an isosceles triangle ABC in which  $AB=AC$ , given that—(a)  $BC=2\frac{1}{2}$  in.,  $\angle B=68^\circ$ . (b)  $BC=6$  cm.,  $\angle A=72^\circ$  (c)  $AB=2$  in.,  $\angle A=48^\circ$ . (d)  $AB=7$  cm.  $\angle C=75^\circ$ , and find the area in each case.

19. On a base of 5.2 cm. construct an equilateral triangle and find its area.

20. The legs of a pair of compasses are 8 in. long and the angle between them is (1)  $60^\circ$ , (2)  $90^\circ$  and (3)  $75^\circ$ . Find by means of a figure the distance between the extremities of the legs in the three positions

**21** The legs of a pair of compasses are each of length 10 cm. What angle must they contain, when the compasses are set for describing a circle of radius 8 cm ?

**22** A pair of compasses are used to describe a circle of radius 6 cm. If the equal legs are inclined to each other at an angle of  $4\frac{1}{2}^\circ$  find the length of each leg

**23.** The legs of a pair of compasses which are each of length  $4\frac{1}{2}$  inches are opened out to an angle of  $33^\circ$ . What will be the radius of the circle described with them ?

**24.** On a base of 2 in construct an isosceles triangle in which (1) each of the base angles is double the vertical angle and (2) the vertical angle is double each of the base angles.

**25.** Construct a triangle ABC whose perimeter is 7.2 in. and whose sides,  $a$ ,  $b$  and  $c$  are as 3 : 4 : 2. Measure all the angles

**26** On a st line BC 6.2 cm long construct a triangle ABC whose angles A, B and C are in the ratio of 3 : 5 : 7.

**27** Construct a triangle ABC given that  $a = 2.6$  in,  $c = 3.1$  in. &  $\angle B = 85^\circ$  On a straight line QR 6.4 cm. long describe a triangle PQR which resembles in shape the triangle ABC (BC and QR are the bases.)

**28.** Construct a triangle (1) having for its longest side a straight line 3 in long and similar to the triangle in Q 2 (a) & (2) having for the shortest side a straight line 6 cm long and similar to the triangle in Q 2 (a)

**29.** Construct a triangle ABC given (1)  $a = 3.2$  in,  $\angle B = 72^\circ$  and the perpendicular from A to BC = 2 in, (2)  $BC = 6.4$  cm,  $AB = 5$  cm. and the perpendicular  $AD = 4$  cm.

**30** In a  $45^\circ$  set-square the greatest side is 6 in. Draw the figure and measure the other two sides

**31.** The shortest side of a  $60^\circ$  set-square is 8 cm. Draw the figure and find the length of the greatest side

**32.** The corners A, B and C of a triangle are 4.2 cm, 5.6 cm. and 3.4 cm. from a point O inside the triangle. If  $\angle AOB = 140^\circ$  and  $\angle BOC = 120^\circ$ , construct the triangle

**33** Construct a triangle ABC given that  $a = 2.6$  in  $\angle B = 40^\circ$  and  $b = 2$  in. How many solutions are there ? Measure the remaining sides and angles. What kinds of triangles are they ?

**34.** Construct an acute angled triangle ABC given that  $BC = 2.8$  in,  $AC = 2.2$  in and  $\angle B = 40^\circ$  If this figure represents a field on a scale of 1 in = 1 furlong, find its area in acres

**35.** Construct an obtuse angled triangle  $\triangle ABC$  given that  $a=6.2$  cm  $b=5.4$  cm and  $\angle B=38^\circ$ . If the figure represents a field on a scale of 1 cm = 1 furlong, find its area in acres.

**36.** PQR, a  $60^\circ$  set-square right-angled at P, is placed on a rectangular drawing board ABCD so that PQ is parallel to AB. P is 6.3 in from A and 11.5 in from B and the shortest side PQ of the triangle PQR is 6 in. If  $AB=15$  in,  $AD=18$  in, draw a figure to show the position of the set-square on the board.

**37.**  $\triangle ABC$  is a triangular plot of ground whose sides AB, BC and CA measure 4.3, 5.1 and 4.8 chains respectively. A point P on a straight road lies on AB produced and is 2.8 chains from B while another point Q on the same road is on BC produced and is 3.2 chains from C. Find, from a figure, the distance of C from the road.

**38.** There are two routes from A to B. One goes straight from A to B and the other goes straight from A to C and then straight from C to B. If the perpendicular distance of C from AB is 1 mile and if  $\angle CAB$  is equal to  $32^\circ$  and  $\angle CBA=45^\circ$ , find by how much one route is longer than the other.

**39.** O is the position of a gun in a fort having a range of 10 kilometres. A ship moves from a point P 16 km. from O in a direction which makes an angle of  $25^\circ$  with PO. Find, by drawing to scale, the distance the ship can travel before it first comes within the range of the gun. If the rate of motion of the ship is 18 km. an hour, find, to the nearest minute, how long the ship in its path will be exposed to the action of the gun.

**40.** State why triangles cannot be constructed in the following cases:—

1.  $a=2.8$  in,  $b=3.2$  in. and  $c=6.1$  in
2.  $\angle A=48^\circ$ ,  $\angle B=92^\circ$  and  $\angle C=54^\circ$
3.  $b=c=4$  cm, and  $\angle B=92^\circ$
4.  $b=6.2$  in.,  $c=5.4$  in and  $\angle C=104^\circ$ .
5.  $c=5$  cm,  $b=3$  cm. and  $\angle B=45^\circ$ .
6.  $a+b+c=2+1+3$  and perimeter 5 + in.

### QUADRILATERALS

**41.** Construct a quadrilateral ABCD given that—

$AB=2.2$  in.,  $BC=2$  in.,  $CD=2.4$  in.,  $DA=1.6$  in.,  $AC=2.7$  in

$AB=5$  cm.,  $BC=5.6$  cm.,  $CD=4.8$  cm.,  $DA=5.2$  cm.,  $\angle A=110^\circ$ .

$AB=2.6$  in.,  $\angle A=72^\circ$ ,  $\angle B=115^\circ$ ,  $BC=2.9$  in. &  $AD=2$  in.

$BC=5.8$  cm.,  $\angle C=78^\circ$ ,  $\angle D=132^\circ$ ,  $\angle A=80^\circ$   $D=6$  cm.

$BC=6.4$  cm.,  $BD=7.2$  cm.,  $AB=5.8$  cm.,  $CD=5$  cm.,  $AC=5.7$  cm.

$AB = 2.3$  in.,  $AC = 2.6$  in.,  $\angle BAC = 48^\circ$ ,  $AD = 2$  in.,  $CD = 2.1$  in.

$AB = 5.6$  cm.,  $\angle BAC = 36^\circ$ ,  $\angle ABD = 54^\circ$ ,  $AC = 6.2$  cm.,  $BD = 5.8$  cm.

$AB = 2.6$  in.,  $BC = 2$  in.,  $AC = 2.8$  in.,  $\angle ACD = 63^\circ$ ,  $CD = 2.5$  in.

$AB = 4.8$  cm.,  $AD = 5.2$  cm.,  $BD = 5.8$  cm.,  $\angle DBC = 70^\circ$ ,  $\angle DCB = 50^\circ$ .

$BD = 2.4$  in.,  $\angle CBD = 47^\circ$ ,  $\angle C = 93^\circ$ ,  $AB = 2.1$  in.,  $AD = 2$  in.

$AB = 3.5$  in.,  $BC = 2.4$  in.,  $AD = 2$  in.,  $AE = 1.8$  in.,  $BE = 1.8$  in.

E being the point of intersection of the diagonals. Measure the remaining angles and sides and find its area.

**42.** ABCD is a quadrilateral field whose sides AB, BC, CD and DA are 160 yds, 192 yds., 144 yds. & 256 yds, in length respectively and  $\angle A = 80^\circ$ . Draw a plan of the field and find its area.

**43.** ABCD is a garden in which AB runs north and AD runs east. If  $AB = 120$  yds,  $AC = 140$  yds.,  $BC = 100$  yds. and  $CD = 160$  yds., draw its plan to scale and find its area.

**44** PQRS is a rectangular hall 60 ft by 24 ft. A person walking along a foot path XY finds that, at a certain point A he is 32 ft. from P and in a line with SP, the longer side of the hall. At another point B he is in a line with QP and 20 ft from P. Draw a plan of the building and the foot path and find the distance of P from XY.

**45** ABCD is a garden in which AB runs north and is 240 yds long. AD runs north-east and is 180 yds long. BC runs east and is 120 yds. long. Draw a plan of the garden and mark in it the position of a well 80 yds. from C and 100 yds from AB.

**46** The corners A, B, C & D of a quadrilateral ABCD are 1.8, 2.2, 1.9 & 2 inches respectively from a point O within it. If  $\angle AOB = 110^\circ$ ,  $\angle BOC = 72^\circ$  and  $\angle COD = 123^\circ$ , construct the quadrilateral and measure its sides.

**47** ABCD is a quadrilateral whose diagonals cut at right angles.  $AB = 2.4$  in.,  $\angle ABD = 72^\circ$ ,  $AD = 2.6$  in. and  $CD = 2.2$  in. Draw the quadrilateral and if this represents the plan of a field on the scale of 1 inch = 10 chains, find its area in acres.

**48.** ABCD is a quadrilateral in which E and F are the feet of the perpendiculars from A and C on BD. If  $BD = 8$  cm.,  $BE = 3$  cm.,  $BF = 6$  cm.,  $DA = 7.2$  cm. and  $BC = 7.5$  cm., draw the quadrilateral and find its area.

**49.** A man walks 4 miles along a straight road, then turns to his right through half a right angle and walks 3 miles. He then turns through  $120^\circ$  towards his right and walks 2 miles. Find how far he is from the starting point.

## PARALLELOGRAMS.

Verify experimentally the truth of the following theorem —

*When a st. line cuts two parallel st. lines, (1) alternate angles are equal, (2) corresponding angles are equal and (3) the sum of the interior angles on the same side of the cutting line is two rt. angles.*

Which of the above properties is used in drawing parallel st lines ?

Draw two parallel st. lines AB and CD. Take pts K, L, M and N on CD and find their distances from AB. Similarly take pts P, Q, R and S on AB and find their distances from CD. What is your inference ?

Draw a st. line AB and mark a pt. C 2 in. from AB. Through C draw DCE parallel to AB.

Draw a st line CD parallel to a given st line AB, the distance between them being 6'4 cm.

*A parallelogram is a quadrilateral in which the opposite sides are parallel.*

Properties —

*The opposite sides and angles are equal and the diagonals bisect each other.* Verify this experimentally.

**50** Construct a parallelogram ABCD given that,

- |                     |                           |                       |
|---------------------|---------------------------|-----------------------|
| (a) $AB = 2$ in.,   | $BC = 1'8$ in.,           | $\angle A = 84^\circ$ |
| (b) $AB = 4'8$ cm., | $BC = 5'2$ cm.,           | $BD = 6'4$ cm.        |
| (c) $AB = 2'6$ in., | $\angle BAC = 36^\circ$ , | $AD = 2'8$ in.        |
| (d) $AB = 5$ cm.,   | $\angle DCB = 52^\circ$ , | $AC = 8'6$ cm.        |
| (e) $AB = 2'5$ in., | $BD = 2'8$ in.,           | $AC = 3'2$ in.        |

Measure the remaining sides and angles and find the area.

**51** The diagonals of a parallelogram are 5 in. and 7 in. long and cut at an angle of  $48^\circ$ . Measure the angles of the parallelogram and the lengths of its sides.

## RHOMBUS.

*A rhombus is a parallelogram in which the adjacent sides are equal.*

Properties —

*The diagonals of a rhombus bisect each other at rt. angles.* Verify this experimentally.

**52** Construct a rhombus ABCD given that (1)  $AB = 2'2$  in. &  $\angle A = 48^\circ$ , (2)  $BC = 6'4$  cm. &  $AC = 8$  cm, (3)  $AC = 4$  in &  $BD = 3$  in. (4)  $BD = 7'8$  cm. &  $\angle A = 72^\circ$ , and find the area.

## TRAPEZIUM.

*A trapezium is a quadrilateral which has only one pair of sides parallel. An isosceles trapezium is one in which the oblique sides are equal.*

## Properties —

*In an isosceles trapezium the oblique sides are equally inclined to the base and the st. line joining the middle points of the two parallel sides is at right angles to them. Verify this experimentally.*

**53** Construct a trapezium ABCD, AB and CD being the parallel sides with the following data and find the area—

(a)  $AB = 2.6 \text{ in.}$ ,  $\angle A = 72^\circ$ ,  $\angle B = 68^\circ$ ,  $AD = 2 \text{ in}$

(b)  $AB = 6 \text{ cm.}$ ,  $\angle A = 80^\circ$ ,  $AD = 5.4 \text{ cm.}$ ,  $BC = 5.8 \text{ cm}$

(c)  $AB = 2.4 \text{ in.}$ ,  $BC = 1.8 \text{ in.}$ ,  $CD = 3.2 \text{ in.}$ ,  $AD = 2 \text{ in}$

**54.** The parallel sides of a trapezium are 110 ft. and 154 ft and the other sides are 55 ft and 66 ft respectively. Find its area.

**55.** The cross section of a railway road is a trapezium 14 ft wide at the top, 20 ft at the bottom and 6 ft in height. If the oblique sides are equally inclined to the base, draw a section of the road and find its area.

**56.** The oblique sides of a trapezium are both inclined to the base at an angle of  $35^\circ$  and the parallel sides are 20 cm and 28 cm in length. Draw a figure and find its area

**57** A piece of land in the form of a four-sided figure has two of its sides parallel and of lengths 320 yards and 200 yards, and a third side perpendicular to them and 140 yards long. The fourth side is a foot path which is to be moved so as to make the field rectangular without change in area. Show how the fourth side must be altered. What is the area of the field in acres?

**58.** To reduce a quadl. ABCD to a triangle,—Join BD. Through C draw CE parallel to BD meeting AB produced at E. Join DE. ADE is the reqd. triangle.

Reduce the quadls  $a$ ,  $b$ ,  $c$  and  $d$  in Q 41 to triangles.

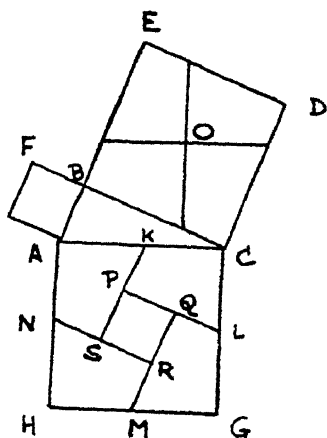
## THE THEOREM OF PYTHOGORAS.

*In a rt. angled  $\Delta$ , the square on the hypotenuse is equal to the sum of the squares on the sides containing the rt. angle*

## Experimental Verification.

*First Method*

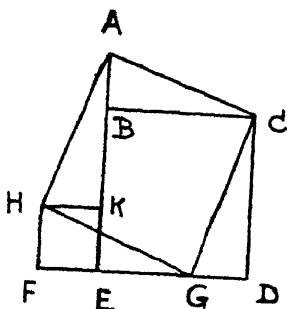
Draw a  $\triangle ABC$ , right angled at B. On AB, BC and CA draw the squares AF, BD and CH as shown in the figure. Take one of the two smaller squares, say BD, and find O, the pt. of inter-section of its diagonals BD and CE. Through O draw st. lines parallel, and perpendicular, to the hypotenuse AC. By paper cutting and super-position it can be shown that the four parts into which the square BD has been divided exactly coincide with one another. Through K, L, M and N, the mid pts. of AC, CG, GH and HA the sides of the square ACGH, draw st. lines parallel to AB and BC as shown in the figure. The newly formed figure PQRS can be shown by super-position to coincide exactly with the sq. AF and the other four parts KPLC, LQMG, MRNH and NSKA with the four equal parts of the square BD.



Hence square CH = square AF + square BD

*Second Method*

Draw a  $\triangle ABC$  right angled at B. On BC describe the square BCDE. Produce DE to F so that EF = AB. On EF draw the square EFHK, which is equal to the square on AB. In DE take a pt G such that DG = AB. Make a cut along CG and another along HG. By superposition it will be seen that the  $\triangle CGD$  and  $\triangle HFG$  will coincide exactly with the  $\triangle ABC$  and the  $\triangle AHK$ .



Now sq. BD + sq. EH = Fig. HKBCG +  $\triangle CGD$  +  $\triangle HFG$ .

= Fig. HKBCG +  $\triangle ABC$  +  $\triangle AHK$ .

= Fig. ACGH which can be easily shown

to be a square by measurement.

Hence square on AB + square on BC = square on AC

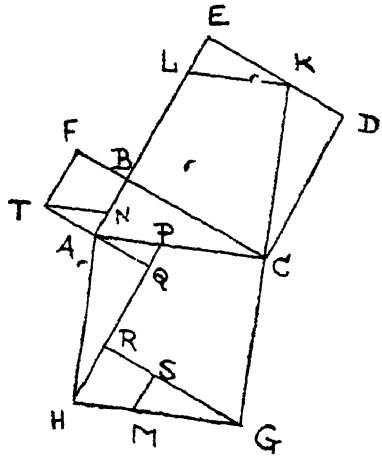
*Third Method. (The Hindu method.)*

Draw a  $\triangle ABC$  right angled at B. On AB, BC and CA draw the squares AF, BD and CH respectively.

Produce GC to meet DE at K  
Through K draw KL parallel to CA  
cutting EB at L. Through T draw  
TN parallel to AC cutting AB at N

Through H draw HP parallel  
to AB cutting AC at P. Produce TA  
to cut HP at Q. Through G draw  
GR parallel to BC cutting HP at R.  
In GH take a point M so that  $GM = KL$ .  
Through M draw MS parallel to HP  
cutting GR at S.

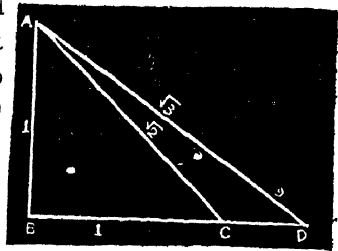
By paper cutting and superposition it can be shown that the triangles CDK, KEL and TAN respectively coincide with the triangles AQH, GSM and AQP, and that the quadrilaterals CKLB and TFBN respectively coincide with CGRP and HRSM.



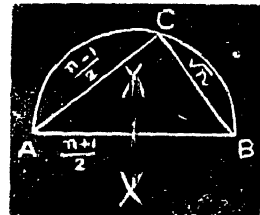
Hence the sq on  $AC =$  the sq on  $AB +$  the sq on  $BC$

### Square Root

1 Take a straight line AB and draw BCD at right angles to it. Let AB be 1 inch long. Cut off BC equal to AB. Then  $AC = \sqrt{2}$  inches. Cut off BD along BCD = AC. Then  $AD = \sqrt{3}$  inches. Then cut off BE = AD. Then  $AE = \sqrt{4}$  inches and so on. Thus the square root of any number can be got geometrically.

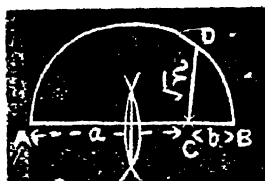


2 To find the square root of any number  $n$ , take a straight line AB equal to  $\frac{n+1}{2}$  units in length. On AB as diameter describe a semicircle. With A as centre and AC equal to  $\frac{n-1}{2}$  such units as radius, draw an



arc cutting the circumference at C. Then the length of BC will be  $\sqrt{n}$  such units.

3. Split  $n$  into two factors  $a$  &  $b$ . Take a st line ACB equal to  $a+b$  units, ( $AC=a$  units) On ACB as diameter describe a semicircle. At C erect a perpendicular cutting the circumference of the circle at D. Then CD will be  $\sqrt{n}$  units in length.



Find geometrically the square root of 3, 5, 7, 13, 27, 61 & 196

Draw a straight line  $\sqrt{5}$ ,  $\sqrt{3}$  and  $\sqrt{2}$  times the given straight line

### Circles.

Verify experimentally the following theorems —

1 Every pt. on the rt. bisector of a st. line is equidistant from its two ends

2 The perpendicular from the centre of a circle to a chord bisects it

3 The perpendicular bisector of a chord passes through the centre

4 The st line joining the mid. pt of a chord and the centre of the circle is at rt angles to the chord

5 Equal chords of a circle are equidistant from the centre

6 Chords of a circle equidistant from the centre are equal.

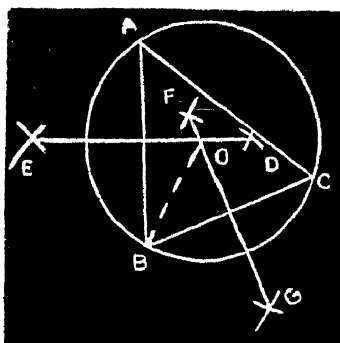
7 In a circle or in equal circles equal chords cut off equal arcs

8 In a circle or in equal circles if two arcs are equal, their chords are equal.

### Circumcircles

1 To draw the circle passing through three given points A, B & C.

A & B are two points 2.6 inches apart. Find a point C, 1.8 in. from A and 2.2 in. from B. Draw the  $\triangle ABC$ . Draw the perpendicular bisectors of AB and BC cutting at O. Measure the lengths OA, OB & OC. With O as centre and OA as radius describe a circle. The circle is called the circumscribing circle and O is called the circumcentre of the  $\triangle ABC$ .



2 Draw (1) an acute-angled, (2) a right-angled, (3) an obtuse-angled triangle. Draw their circumcircles. Repeat this with different

triangles and state any relation that you notice between the position of the circumcentre and the nature of the triangle.

3. Similarly draw the circumcircles of the triangles in question 2, Ex. XXII.

*To bisect a given arc ACB*

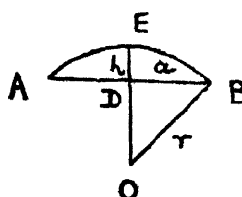
Join AB, draw its right bisector DE cutting AB at D and the arc at E. Then E shall be the mid pt. of the arc.

DE, the st. line joining the mid. pts of the chord and of the arc is called the *height of the arc*.

4. Given the chord of an arc and its height, to find the radius of the arc

Draw a st. line AB equal to the length of the chord (Choose a convenient scale if necessary and note it close to the figure). Draw its rt bisector CDE cutting AB at D. Make DE equal to the height of the arc. Draw the circle passing through the three points A, E and B. The radius of this circle is the required radius

*Calculation.*



Let  $AB = 2a$  units,  $DE = h$  units and the radius  $OB = r$  units. In the right angled  $\triangle OBD$

$$OB^2 = OD^2 + DB^2.$$

$$r^2 = (r-h)^2 + a^2$$

$$= r^2 - 2rh + h^2 + a^2$$

$$2rh = h^2 + a^2.$$

In the right angled  $\triangle ADE$

$$AE^2 = AD^2 + DE^2$$

(i.e.)  $b^2 = a^2 + h^2$  where  $b$  units is the length of AE, the chord of half the arc.

The span of an arch is 48 ft. and its height is 8 ft. Find by drawing to scale and measurement, the radius of the arch and check your result by calculation.

Work all the questions under *chords* geometrically.

5. *The angle in a semicircle is a rt angle*—Take any straight line AB. On AB as diameter describe a semicircle. Take any point P on the circumference. Draw AP and BP and measure the angle APB. Take several positions of P and draw your inference.

6. (a) Construct a right-angled triangle ABC given that

(1) hyp.  $AC = 6.4$  cm.,  $AB = 4.8$  cm

(2) hyp  $AC = 2.6$  in.,  $\angle A = 52^\circ$ .

(b) Construct an isosceles right angled  $\triangle$  having its hypotenuse equal to 6 cm. without using the protractor.

7. Construct a quadrilateral ABCD in which

- (1)  $AB = 2$  in  $\angle B = 80^\circ$   $AC = 2.8$  in  $BD = 2.8$  in.  $\angle D = 90^\circ$   
 (2)  $AB = 3.5$  in  $AD = 2.4$  in  $CD = 2.9$  in  $\angle A = 100^\circ$  &  $\angle ACB = 90^\circ$ .

8. P and Q are two points and a snail is in a line with them at distances of 18 ft. and 8 ft from P and Q respectively. It moves at right angles to PQ and in 10 minutes it reaches a place at which PQ subtends a right angle. Find its speed by drawing to scale and by calculation.

9. Two boys start from a point in a diameter of a circular plot of ground. One walks along the diameter and the other at right angles to it. The first reaches the extremity of the diameter after walking 900 yds. and the latter reaches the boundary of the island after walking 600 yds. Find the area of the plot, and the shortest distance of the starting point from the boundary.

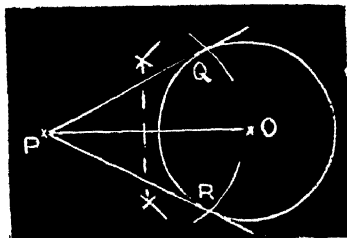
10. On a black board measuring 4 ft. by 3 ft. draw a triangle so that (1) one vertex is 18 in. from the top left corner of the black board, and 24 in. from the bottom left corner (2) another vertex is 24 in. from the top right corner, and 18 in. from the bottom right corner (3) the third vertex is 24 in. from the bottom right corner and the angle at the vertex is a right angle. Draw a plan showing the position of the triangle relative to the sides of the black board. State your scale below the plan. What is the length of the hypotenuse? (1911)

11. AB and BC are two straight roads at right angles to each other  $AB = 240$  yds., and  $BC = 360$  yds. Find the position of a peg D which is equidistant from A and B and at which BC subtends a right angle.

### Tangents.

1. O is the centre of a circle of radius 2.5 inches. To draw the tangent at a point P on the circumference, join OP and erect a perpendicular TPQ to OP at P. TPQ is the required tangent. Similarly draw tangents at points A, B and C on the circumference.

2. To draw tangents to a circle whose centre is O from an external point P. Join OP & on OP as diameter describe a circle cutting the given circle at Q and R. Join PQ and PR. PQ and PR are the two tangents.



$$[PQ^2 = PR^2 = OP^2 - r^2 \text{ where } r \text{ is the radius of the circle.}]$$

3 From a point P 2.6 inches from the centre O of a circle of radius 1 in draw tangents to the circle and measure their lengths. Check your result by calculation.

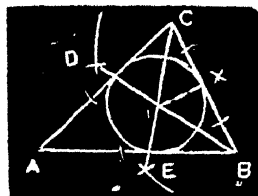
4. From a point P 7.5 cm. from O, the centre of a circle of a radius 2.1 cm., draw tangents to the circle and measure them. Check your result by calculation.

### Inscribed Circles.

Verify experimentally that *every point on the bisector of an angle is equidistant from its arms*.

1 To draw the inscribed circle of a given triangle

Draw a triangle ABC in which  $AB = 2$  in.  $BC = 2.5$  in. and  $CA = 2.8$  in. in length. Draw BD and CE the bisectors of the angles B and C. Let them cut at I. (Join AI and measure the angles BAI and CAI. What is your inference?) From I draw  $Ix$ ,  $Iy$  and  $Iz$  perpendicular to the sides BC, CA and AB respectively. With I as centre and  $Ix$  as radius describe a circle. This is called the inscribed circle and I is called the in-centre. (How are the sides AB, BC and CA related to this circle?)



2 Draw the inscribed circles of the triangle in Q 2 Ex XXII and Qs 24—27 and measure the in-radius in each case.

3. Draw the greatest circle that can be described in a triangle of sides 2 in., 3 in. and 4 in. and find its area.

4. Draw the greatest circle that can be inscribed (i) in a square of side 8 cm. and (ii) in a rectangle 5 in.  $\times$  3 in.

5 AB and BC are two roads inclined to each other at an angle of  $72^\circ$ .  $AB = 180$  yds and  $BC = 270$  yds. Find the position of a rest house D which is equidistant from A and B and from the two roads.

### Regular Polygons

1 Show by drawing any polygon of 5, 6, 7, 8, 9 and 10 sides and measuring its angles that the sum of the interior angles is equal to  $2n - 4$  right angles, where  $n$  is the number of sides.

2. Calculate the value of each of the angles of regular polygons of 4, 6, 8, 10 and 20 sides.

3. Find the number of sides of a regular polygon each of whose interior angles is equal to (1)  $144^\circ$ , (2)  $150^\circ$ , (3)  $162^\circ$ , (4)  $174^\circ$ .

4 To describe a regular pentagon on a base of 2 in. Take a st. line  $AB = 2$  in. At B make an angle  $ABC = 108^\circ$ . Cut off  $BC = 2$  in. At C make an angle  $BCD = 108^\circ$ . Cut off  $CD = 2$  in. With A

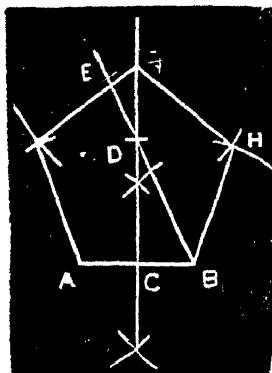
and D as centres and with 2 in. as radius draw arcs cutting at E. Join AE and DE. ABCDE is the required pentagon. Find its area by any method.

5. Similarly describe a regular hexagon and a regular octagon on a base of 2 in. and find the area of the figure in each case.

6. *Second method for the construction of a regular pentagon on a given base AB.*

Draw CDF bisecting AB at right angles at C

Set off  $CD = AD$  Join BD Produce BD to E, making DE equal to AC With centre B and radius BE, draw an arc cutting CDF at F With centres A, F and B and radius equal to AB, draw arcs cutting each other at G and H. AGFHB is the required pentagon



7 *Alternative methods for the construction of a regular hexagon on a given base AB.*

(a) On AB describe an equilateral triangle AOB With O as centre and OA as radius describe a circle. Step off chords BC, CD, DE & EF each equal to AB. Join AF. ABCDEF is the required hexagon Find its area by any method

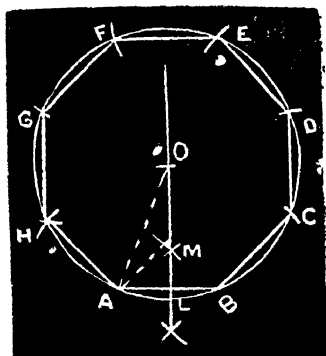
(b) Draw an equilateral triangle each of whose sides is 3 times the given base AB Trisect the three sides The six points of division form the angular points of the regular hexagon

8. *Alternative methods for the construction of a regular octagon on a given base AB*

(a) On a given base AB as hypotenuse describe an isosceles right angled triangle ABP Produce AB both ways to K and L so that  $KA = BL = AP$ . On KL describe a square KLMN Cut off KH, NG, NF, ME, MD and LC along the sides of the square equal to KA. Then ABCDEFGH will be the required octagon.

(b) Draw the perpendicular bisector LMO of AB cutting AB at L.

Cut off  $LM=AL$  Along LMO cut off  $MO=MA$  With O as centre and OA as radius describe a circle. Step off chords BC, CD, DE, EF, FG and GH each equal to AB. Join AH. ABCDEFGH is the required octagon



**9** Draw any regular polygon and draw the perpendicular bisectors of any two adjacent sides. Let them meet at O. Join O to the other angular points. Measure the two parts into which each of the angles at those points is divided. What is your inference? *In a regular polygon the perpendicular bisectors of the sides and the bisectors of the interior angles meet at a point*

With O as centre and OA as radius describe a circle. This circle is called the circumscribing circle. With O as centre and OX the perpendicular from O to AB as radius, describe a circle. This circle is called the inscribed circle. How are the sides of the regular polygon related to the two circles?

On a base of 5.6 cm describe a regular

(1) pentagon, (2) hexagon, and (3) octagon

Draw the circumcircle and the inscribed circle in each case

**10.** *To inscribe a regular polygon of  $n$  sides in a given circle*

Let O be the centre of the given circle. Draw any radius OA.

At O in OA make an angle  $AOB = \frac{360^\circ}{n}$  (the other arm cutting the circumference at B). Join AB. Step off chords BC, CD, etc., each equal to AB. ABCDE etc. is the required regular polygon

**11.** In a circle of 2.8 inches radius inscribe a regular

(1) pentagon (2) hexagon and (3) octagon

**12.** *Alternative method for inscribing a regular hexagon in a circle*

Place a chord AB = the radius of the circle. Step off chords BC, CD, etc. each equal to AB. ABCDEF will be the required hexagon.

**13** *To circumscribe a regular polygon about a given circle with centre O*

Draw OA, OB, OC, etc., such that  $\angle AOB = \angle BOC = \angle COD$  etc.  $= \frac{360^\circ}{n}$  where n is the number of sides of the polygon. At A, B, C & D draw tangents intersecting at P, Q, R, S. Then PQRS is the required polygon.

**14.** About a circle of radius 5.8 cm circumscribe a regular (1) pentagon, (2) hexagon and (3) octagon.

**15.** Compare (1) the area of a regular hexagon with that of the equilateral triangle, and (2) the area of a regular octagon with that of the square, formed by joining the alternate angular points.

**16.** In a circle of radius 2 in describe (1) an equilateral triangle, (2) a square and (3) a regular hexagon. Draw tangents to the circle at the angular points of the triangle, the square and the hexagon and measure the sides and the angles of the figure formed by the tangents in each case.

### Similar Triangles

**1.** Draw a triangle ABC. Through D a point in AB draw DE parallel to BC cutting AC in E. Find the values of the ratios

$\frac{AB}{AD}, \frac{AC}{AE}$  &  $\frac{BC}{DE}$  What is your inference?

**2.** Draw a triangle ABC in which  $BC = 1.8$  inches,  $\angle B = 52^\circ$  and  $\angle A = 78^\circ$ . Draw another triangle DEF in which  $EF = 1.2$  in,  $\angle E = 52^\circ$ ,  $\angle D = 78^\circ$ . Find the ratios of the corresponding sides.

**3.** Draw a triangle ABC right angled at B having  $AB = 3$  cm. and  $AC = 5$  cm. Take a point D in AB such that  $AD = 1$  cm. and erect a perpendicular DE meeting AC in E. From E draw EF perpendicular to BC. Measure the lengths of DE, FC and EA. Check your result by calculation.

**4.** Draw triangles of the same form as those in Q. 2, Ex XXII the sides of which are to the corresponding sides of those in Q. 2 as 5 : 3. Compare the areas in each case.

**5.** An upright pole 7 ft high stands 4 ft from a lamp post and the shadow of the pole cast by the lamp is  $3\frac{1}{2}$  ft. long. Find the height of the lamp.

**6.** A man places a 3 ft stick upright on the ground at a distance of 16 ft. from a lamp post. He finds that the shadow of the stick thrown by the light is 4 ft. long. Find the height of the lamp post.

7. A boy 5 ft high, wishing to find the height of a tower stands on the same horizontal level as the bottom of the tower, so that the end of his shadow coincides with the end of the shadow of the tower. If he is 32 ft away from the tower and his shadow is 4 ft long, find the height of the tower.

8. A man 6 ft. in height, standing 7 ft from a lamp post observes that his shadow cast by the light at the top is  $2\frac{1}{3}$  ft. in length. How long would his shadow be, if he were to move 8 ft away from the post?

9. A man 5 ft. 6 in in height is  $13\frac{1}{2}$  ft away from the point directly under a lamp. His shadow thrown by the lamp is  $4\frac{1}{2}$  ft long. Find the height of the lamp above the ground. The man moves away to a point distant 20 ft 3 in from directly under the lamp. What is the length of his shadow in his new position?

10. A boy whose height is 5 ft standing 18 ft from a lamp post observes that his shadow cast by the light at the top is 6 ft in length. How high is the light above the ground? Find the distance between a man and the post, if the length of his shadow is 6 ft, given that the height of the man is 6 ft.

11. A man wishing to ascertain the height of a tower, fixes a rod 11 ft in length vertically in the ground at a distance of 120 ft from the tower. On retiring 15 ft farther from the tower he sees the top of the rod in a line with that of the tower. If the observer's eye is 6 ft above the ground, find the height of the tower.

12. A room 24 ft.  $\times$  16 ft has a verandah outside it running parallel to the length of the room, the roof of the verandah being a continuation of the roof over the room. The height of the ridge is 18 ft and the greatest and the least heights of the verandah are 10 ft & 6 ft. Find the width of the verandah.

13. To ascertain the width of a canal, a man took two rods  $3\frac{1}{2}$  ft and 5 ft. in length. The shorter he fixed vertically on one bank, and then retired at right angles to the canal, until, on resting the other rod vertically on the ground, he saw the ends of the two rods in a line with the remote bank. The distance between the rods was 45 ft. What is the width of the canal?

14. ABCD is a trapezium, AB & CD being the two parallel sides AB=9 cm, BC=6 cm, CD=12 cm and DA=6 cm. CB & DA are produced to meet at O. Find the lengths of OA and OB.

### Paper Folding

1. Place two ink dots A & B on a piece of thin white paper. Fold the paper so that A coincides with B. How is the crease related to AB? Take points P, Q, R, S, etc., on the crease and measure their distances from A & B. What is your inference?

2. Take a triangular sheet of paper ABC. Fold the triangle so that (1) A coincides with B, (2) B coincides with C, and (3) C with A. What do you notice about the three creases? Find the distance of the point of their intersection from A, B and C.

3. Take a sheet of paper ABCD in the form of a parallelogram. Fold it in succession so that A coincides with B, B with C, C with D and D with A. What is the figure formed by the creases? Measure its sides and angles. Examine the corresponding figure in the case of a rectangle.

4. Take a circular sheet of paper of centre O. Fold it along any diameter AB. Fold the circle so that A & B coincide with O. Show (by measuring the sides and angles) that the six points now marked on the circumference by the three creases are the angular points of a regular hexagon.

5. Take a triangular sheet of paper ABC. Fold it so that AB lies along AC. How is the crease related to the angle A? Take points P, Q, R, S, etc. on the crease and measure their distances from AB and AC. What is your inference? Similarly fold the triangle so that BA falls upon BC and CA upon CB. What do you notice about the three creases? Find the distance of the point of their intersection from the three sides.

6. Fold a sheet of paper ABCD in the form of a parallelogram so that AB lies along AD, BA along BC, CB along CD, and DC along DA. What kind of figure is formed by the four creases? Examine the case with a rectangle.

7. Take a circular sheet of paper and inscribe a triangle ABC. Fold the circle so that (1) B coincides with C, and (2) AB falls upon AC. What do you notice about the two creases?

8. Take a circular sheet of paper of centre O. Fold it along any diameter AB. Then fold this semicircle so that A coincides with B. Fold this quadrant so that the two bounding radii coincide. Show that the eight points marked on the circumference by the four creases form the angular points of a regular octagon.

9. Take a square sheet of paper ABCD. By folding it along the two diagonals find O, the middle point of AC. Now fold the

square along AC. Then fold the triangle ABC so that A coincides with C. Again fold the triangle OAB so that OA lies along OB. Then fold the triangle obtained so that one arm of the angle at O lies along the other. Cut off the projecting portion. Unfold the figure and show that the figure obtained is a regular octagon.

### EXERCISE XXIII.

#### Ratio.

1. A money-lender charges 2 pies per Re per mensem, while another charges 12% per annum. Find the ratio of the two rates.
2. A and B share the expenses of a feast in the ratio of  $x : y$ . What fraction of the expenses does each of them bear? How much does B bear less than A?
3. Three engines consume coal in the ratio of  $a : b : c$ , if  $x$  tons are distributed among them in the ratio of their consumption, how much coal will be supplied to each?
4. A 36 gal cask is  $\frac{1}{4}$  full of a mixture of wine and water in the ratio of 7 : 1. If 3 gals are drawn off and are replaced by pure wine, find the ratio of wine to water in the cask.
5. A stick is broken into two pieces, the ratio of their lengths being  $a : b$ . If the shorter piece is again broken in the ratio of  $c : d$ , find the ratio of the lengths of the three pieces.  $a$  is greater than  $b$ . Evaluate the result if  $a=4$ ,  $b=3$ ,  $c=5$  and  $d=1$ .
6. An alloy A is composed of copper and zinc in the ratio of 5 : 2, while another alloy B is composed of the same metals in the ratio of 4 : 1. If  $x$  grams of A are melted with  $y$  grams of B, find the ratio of copper to zinc in the newly made alloy.
7. When pure milk costs  $a$  annas per measure, a mixture of milk and water costs  $b$  as. per measure. Find the ratio of milk to water in the mixture. Evaluate the result when  $a=8$  and  $b=6$ .
8. Gingelly oil and ground-nut oil are mixed in the ratio of  $l : m$ . If the mixture costs  $c$  annas a viss, and ground-nut oil  $g$  as. a viss, find the cost of a viss of pure gingelly oil. Evaluate the result when  $c=15$ ,  $g=8$ ,  $l=7$  and  $m=1$ .
9. The sides of a rectangle are as 3 : 2. If both be increased by 8 ft., their ratio will be 4 : 3. Find the dimensions of the rectangle.
10. If  $m$  oz. of gold, 14 carats fine, are mixed with  $n$  oz. of gold, 11 carats fine, so that the resulting mixture may be  $c$  carats fine, find a relation connecting  $m$ ,  $n$  and  $c$ .

11. A plate of 260 grms. in weight is melted and is beaten into two circular plates of the same thickness, their radii being as 2 : 3. Find the weight of the pieces if the weight varies as the square of the radii.

12. Of two sectors, the central angle of the first is double that of the second and the radius of the second is three times that of the first. Compare (1) their areas and (2) the lengths of their arcs.

13. The volumes of two right circular cones are as 45 : 32 and their heights are as 5 : 2. Compare their radii.

#### EXERCISE XXIV.

##### Miscellaneous Examples.

1. The cost of a seventeen days' holiday for a family of 4 adults and one child was as follows —  $4\frac{1}{2}$  tickets at Rs. 2—13—6 each, carriages, etc. Rs. 1—10—6, cost of stay at a boarding-house Rs. 8 each a week, for 2 weeks. Hotel bill for one night Rs. 2—7—6. Excursions Rs. 3—6—0. Miscellaneous items Rs. 1—3—6. Find (1) the total cost of the holiday, (2) the cost per day and the cost per person counting the child as half.

2. The area of a penny is proportional to the square of its diameter. A half-penny and a penny are respectively 2.45 cm. & 3.15 cm. in diameter. Calculate to two decimal places the relative thickness of the two coins. Assume a penny to weigh twice as much as a half-penny.

3. The capital of a company is 5 million pounds. The average weekly income is £18,574 and the average weekly expenditure £12,818. £150,000 a year is set aside for depreciation and the rest is divided among the shareholders. What interest per cent. yearly do the shareholders get for their money?

4. A barometer tube whose internal diameter is 2 cm. is 120 cm. long and is filled with mercury. Find the weight of the mercury, it being given that a cubic centimetre of mercury weighs 13.6 grms. find also its cost at 6 s. 3 d. a kilogram.

5. Allowing an average of 23 inches for each boy to stand in, if 198 boys are arranged in a circle, what will be its radius? If they are arranged in a rectangle of which each long side is double each short side, what will be the length of its diagonal in feet correct to five significant figures? (S. S. L. C. 1912)

6. The estimated cost of an irrigation project is two lakhs and it is expected to yield after deducting for maintenance charges a net

return of 5.2%. Without such deduction, however, the return would be 6.4%. Assuming the maintenance charges to be 12 as per acre find (1) the extent of land proposed to be irrigated, and (2) the water rate per acre proposed to be levied (S. S. L. C. 1912)

7 Two houses are built, one in 3 months and the other in 4 months. The number of workmen engaged on the first is double that employed on the second, and they work one hour a day overtime for which they are paid half as much again as for work done in the ordinary working day of 10 hours. If the sum paid for labour is Rs. 14,715 in all, find how much of this sum was spent on each house.

8 The bridge that spans the Cauvery consists of 32 arches built on piers, each 4 ft. broad and 10 ft. high (from the bed of the river which is supposed level to where the arches commence) and is 660 yards from end to end. How many tons of water pass the bridge per minute, when the river is flowing at the rate of 8 miles an hour and the piers are just under water?

9 The assets of a bankrupt consists of (1) property worth Rs. 8,000, (2) an undiscounted bill for Rs. 500 due 9 months hence at 8%, (3) a loan of Rs. 700 lent 2 years ago at 10% per annum, C.I. and (4) other debts to the amount of Rs. 1,825 of which only 40% is realisable. If he is able to pay his creditors 12 as in the rupee, find the amount of his liabilities.

10 The population of a province is 33,264,000 and there are 99 males to 101 females. Two out of every 11 boys and one out of every 33 girls of school-going age are under instruction. If the boys of school-age form one-seventh of the male population and the girls of school-age form one-seventh of the female population, find the total number of pupils under instruction.

11 Twenty men are employed to make a tank 40 ft. long, 20 ft. broad and 6 ft. deep. They work for 30 days and have just completed one-third of the work, when it is resolved to increase the length of the tank by 10 ft., the breadth by 4 ft. and the depth by 2 ft. How many additional men must be employed in order that the work may be completed in 30 days more?

12 A certain number of men and women subscribe a sum of money, the number of women being 4 times the number of men. Each man subscribes as many annas as there are men, and each woman as many pies as there are women. The total amount subscribed being Rs. 756, find the number of men and women.

**13** A land owner pays his agent 5% on the gross rental of his estate and after paying an income tax of 9 d in the £ on the remainder has £ 2,456—12—5 left. Find his gross rental.

**14.** The materials of an old building were sold for Rs 1,500 upon condition that they should be removed within 30 days under a penalty of Rs 10 per day for every day beyond 30 days. The purchaser employed 40 men at  $3\frac{1}{2}$  as per day to do the work and after selling the materials for Rs 2,365 he cleared Rs. 190 by his bargain. How many days were the men at work?

**15** Light travels at the rate of 96 millions of miles in 8 minutes and 13 seconds and sound at the rate of 1,125 feet per second. If a gun be fired from the moon whose distance from us is 240,000 miles, how long after seeing the flash will we hear the report?

**16** The cost of papering the walls of a room 30 ft. long at 4 s. a sq ft is £ 200, and the cost of matting the floor at Rs 3 per 5 sq ft. is Rs 360. Find the height. If the room has a verandah 9 feet wide all round outside, what will it cost to pave it at Rs 2 a sq yd, the walls being 18 inches thick?

**17** A plot of ground 110 ft by 71 ft is to be enclosed for exercise. A wall having a uniform height of 20 ft is to be raised round so as to enclose an area of 7810 sq ft. The cost of white-washing the walls both in and out at 3 d a sq ft is £ 161. Find the external circuit of the ground.

**18** A detective sets out in pursuit of a thief who had a start of 39 miles. At the end of 4 days it is found that the latter travels 6 miles a day faster than the former, when the former, doubles his speed and overtakes the latter in  $2\frac{1}{2}$  days. Find their rates of travelling and the distance at which the capture took place.

**19** A man's income increases in the ratio of 8 : 7, but his expenses increase in the ratio of 6 : 5. If his income before the change was Rs. 350 and his expenses Rs 320, how much does he save after the change?

**20** A piece of brass 5 kilograms in weight is used for making 10 gram and 5 gram weights. If twice as many 5 gram weights as 10 gram weights are required, what will be the number of each kind?

**21** A square field contains 10 acres and is increased by 2 acres so as to form a rectangle whose shorter side is the side of the square. At how many miles per hour does a man run who runs round it in 48

seconds longer than would be occupied in running round the square field at 12 miles an hour ?

**22.** An ordinary wooden match box contains 70 matches. The section of each match is a square. Five matches are placed side by side, forming a rectangle  $\frac{1}{2}$  in. wide and 2 in. long. Find the internal cubical contents of the box supposing one-eighth of the whole space inside is wasted.

**23.** On a map drawn to a scale of  $\frac{1}{3}$  in. to a mile, a certain estate covers an area of 2.43 sq. in. Find the actual area of the estate in acres.

**24.** A boy measures the length and the breadth of a hall with what he takes to be a yard measure and computes its area to be 1296 sq. yards. But it is found that his yard measure is one inch too long. Find the actual area of the hall and also calculate the error percentage in his calculation.

**25.** A boy measures a room with what he takes to be a foot-rule and computes its area to be 640 sq. ft. But it is found that his foot-rule is  $6\frac{1}{4}\%$  short of a true foot. Find the correct area in sq. ft.

**26.** A ruler supposed to be 6 inches long is actually 6.2 in. in length. It is divided into 6 equal parts and each part into 10 equal parts. When measured with this ruler, the sides of a rectangle are found to be 4.8 in. and 2.6 in. Calculate the actual area of the rectangle.

**27.** In a school the average number of daily absentees is 12% of the whole number of scholars, but if the number of scholars were increased by 41, the same number of absentees would be 8% of the whole, find the number of boys in the school.

**28.** If a metre is 39.37 in. and a kilogram = 2.2 pounds, express a pressure of so many pounds per sq. ft. in terms of its equivalent in grammes per sq. cm. (S. S. L. C. 1912)

**29.** In Q. 21, p. 32 if the wall all round is 14 ft. high and 1 ft. 6 in. thick, find the cost of painting it inside and whitewashing it outside at 4 as. and at 6 ps. per sq. yd. respectively. Allow for a doorway 6 ft. by 4 ft.

**30.** In the centre of a room 25 ft. square there is a square carpet and the rest of the floor is covered with mat worth 2 as. a foot. If carpet costs 6 as. a sq. ft. and the total cost amounts to Rs. 178—2 as., find the length of a side of the carpet.

**S S L C. Examination Papers.**  
**1913.**

1	<i>a</i> Cities.	Population	No. of females to 1000 males
	Madras	518, 660	946
	Madura	134, 130	999
	Trichinopoly	123, 512	1,006
	Calcut	78, 417	928
	Kumbakonam	64, 647	1,064

From the above table find (1) the total population of these five towns and (2) the number of males in each town.

*b* Find correct to 3 significant figures, the value of  $0.923 \times 13215 \times 2654364$

**2** (1) What is Rs 698—12 as in English money, if exchange is at 1 s  $4\frac{1}{2}$  d per rupee?

(2) A man placed Rs. 1,500 as a fixed deposit in a bank paying 6% interest, the interest being added to the capital every year. Four years afterwards the bank failed and paid a dividend of two annas in the rupee. What did he get from the bank?

**3** If a metre is 39 3708 in find correct, to the nearest foot, the difference between 83 kilometres and 51 miles.

**4.** Solve the following equations algebraically and check the result by means of a graph

$$3x - \frac{2}{3}y = 10, \quad \frac{2}{3}x - 1\frac{1}{2}y + 1 = 0.$$

**5.** In a certain bicycle the hind-wheel revolves two and a half times for one revolution of the pedal. If the outside diameter of the hind-wheel is 28 in., express the distance travelled in terms of the number of revolutions of the pedal, and find the distance when the number of revolutions is 500.

**6** (i) Of two cylindrical vessels the diameter of the second is double that of the first, and the height of the second is half that of the first. Compare the capacity of the second with that of the first.  
(ii) If each has some water in it and a stone is immersed first in the one and then in the other, compare the height by which the water would rise in the second with the height by which it would rise in the first.

**7.** (i) Draw four parallel st. lines such that the distance between the first and second is 1 in., between the second and third 2 in., and between the third and fourth  $\sqrt{3}$  in., finding  $\sqrt{2}$  in.

and  $\sqrt{3}$  in. geometrically. (11) Draw a st. line cutting these four parallels and making an angle of  $45^\circ$  with them. What length of this line is intercepted between the second and the third parallels?

8 (1) Draw a triangle whose sides are 1.8 in., 2.4 in. and 3 in., respectively, give the measurement of each angle and state what the area of the circumscribing circle is

(11) Draw a rt. angled triangle and draw the square on each side, then show, by dotted lines and by instructions given below your figure, how to cut up the squares on two sides and by superposition of the cut pieces upon the third square, how to prove that the area of two of the squares is equal to that of the third square.

9. *Omitted, Sphere and frustum of cone*

10 For every acre of wet land a man pays a land revenue tax of Rs 8, and for every rupee of land revenue he pays a local cess of 1 a 6 p. Draw a graph showing the total tax paid up on land varying in extent from 20 to 40 acres. What would be the total tax on 35 acres?

11 Find the cost of whitewashing a room which is 40 ft. by 18 ft. with walls 14 ft. high, allowing for half the area of the following openings, 2 doorways each  $7 \text{ ft} \times 4\frac{1}{2} \text{ ft}$ , 4 windows, each  $3\frac{1}{2} \text{ ft} \times 4\frac{1}{2} \text{ ft}$ , and 2 circular ventilators, each 2 ft in diameter. The wall at each end of the room is as in the figure (given on page 48) the greatest height being 22 ft. Whitewashing 2 as 6 ps per 100 sq. ft.

12. An open rectangular cistern of which the internal length, breadth and depth are as 4 : 3 : 2, is made of metal 1.5 cm. thick and 8 times as heavy as water. If the capacity of the cistern is 12,288 litres, find its weight in kilogram when empty.

13. A book-seller is allowed by a publisher 20% discount on the nominal price of a book and 5% on this last amount for cash. For every dozen books he gets an extra copy for nothing. The book-seller allows his cash customer 4 as. in the rupee off the nominal price. Find, to one decimal place, the book-seller's profit on cash sales.

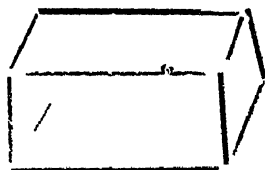
### 1914.

1 The following table gives the number of workers in Textiles in the Madras Presidency in the years 1901 and 1911. Fill in the percentage column and the row of totals (correct to one decimal place.)

Name of textile	No. in		Percentage of increase (+) or decrease (—)
	1901.	1911.	
Cotton (ginning, etc.) ..	24,089	32,553	



8. How many sq in of metal are required to make a tray of the shape shown in the diagram? The adjacent sides of the base measure 9 in and 15 in and the corresponding sides of the top measure 10 in and 16 in. and the width of the strip making the sides is 3 in.



9. In order to find the diameter of a tube of uniform bore, some mercury was poured into it and the height of the column measured. The weight of the mercury was 19.72 grm, the height of the column 20.3 cm. What was the diameter of the tube? (A cub. cm. of mercury weighs 13.6 gram and  $\pi = \frac{22}{7}$ )

10. In 1911 the population of the Madras City was 551,660. Since then the birth rate per annum has been 42 per thousand and the death rate 39 per thousand, and the town has attracted people from outside at the rate of 17 per thousand every year. What will be the population in 1914?

11. *Omitted, Stocks and shares*

12. The water level in the Red Hills lake on the 15th of every month for 12 months from April, 1911 to March, 1912 was 42.1, 40.5, 39.0, 37.9, 36.9, 36.6, 37.3, 39.1, 44.0, 44.3, 43.4 & 43.0

Exhibit the variations in level by means of a smoothly drawn graph and find approximately when the level was (1) the highest and (2) the lowest

### 1915.

1. In a certain year the United Kingdom imported 61,325,694 cwt. of wheat valued at £ 22,934,523, from foreign countries and 41,568,705 cwt. of wheat valued at £ 16,837,425 from British possessions. Find, to the nearest penny, the value per cwt. of imported wheat (1) from foreign countries and (2) from British possessions. Also find, to the nearest integer, what percentage of the total value of the imported wheat is the value of the quantity imported from British possessions.

2. An English sovereign weighs 123.3 grains and contains 91.67% of pure gold. Find the value, to the nearest tenth of a penny, of the gold in a sovereign at £ 3—17—6 for 480 grains.

3. I want to buy 20 yds. of a certain wire which is 0.14 in. in diameter, but I find it is sold only by the pound. Calculate for me the weight of the wire which I want, given that iron weighs 470 lbs. a cub. ft [Use the formula  $v = 0.785 d^2 l$ , where  $v$  is the volume in cub. inches of a piece of wire  $l$  in long and  $d$  in. in diameter.

4 At a show the following kinds of tickets are sold green tickets at 9 pies, white at 3 pies, pink at 6 pies, and yellow at one anna If 'g' green, 'w' white, 'p' pink and 'v' yellow tickets were sold on a day, construct a formula for 'T' the total collection in annas for the day Use your formula to find 'T' if  $g=360$ ,  $w=1760$ ,  $p=480$ ,  $v=80$  Also find 'g' when  $T=762$ ,  $w=920$ ,  $p=440$ ,  $v=72$

5. See Exercise X, Question 49

6. A ladder 12 ft long leans against a wall making with it an angle of  $25^\circ$  Draw the ladder in position representing 1 ft. by  $\frac{1}{4}$  in. Then draw the ladder in a new position with its lower end 2 ft farther from the wall and find by measurement, how much lower the top of the ladder will then be.

7. Take any straight line and mark a point A at a distance of 4 cm from it Now find another point B which is 3 cm from A and 3 cm from the line Find also a point C 2 cm from A at which the line AB subtends a right angle Find, by measurement, the distance of C from the first line

8 A hay-shed (as in Ex. 11, Q. 55) consists of a rectangular space 32 ft long, 16 ft high and 20 ft wide, surmounted by a covering roof whose section is a semi-circle Calculate how many tons of hay can be stored in it, if a ton of hay occupies 300 cub. ft

9. A merchant sells silk of two qualities which cost him Rs. 4 and Rs. 3—4—0 per yard respectively The selling price of the latter is two-thirds that of the former, but the quantity sold is double. He gains 25% on the whole Calculate the selling price per yard of each.

10 In a certain factory the machinery was valued at Rs. 32,500. If it depreciates each year at the rate of 8% of the value which it had at the beginning of the year, find, to the nearest rupee, what its value would be after 4 years.

11 I live three-quarters of a mile from my railway station and take 15 minutes to walk the distance I am accustomed to meet at a certain point some children going to school in the opposite direction. The children take 30 minutes to the mile. One day when I am at my usual time I am 220 yards farther on when I meet them. How much later will the children arrive at school that day than on ordinary days provided they keep their ordinary pace?

Draw three graphs on one diagram to show the position of the children and myself at any time on ordinary days and on the special day mentioned, taking the usual meeting-place and time as origin.

12. Passengers on the railway are allowed a certain weight of luggage free and the rest is paid for at 5 s. 7 d per cwt. If a traveller with luggage weighing 256 lbs. had to pay 8 s 4½ d. for his luggage, find the weight of luggage allowed free and draw a graph connecting the amount of luggage carried and the charges paid.

### 1916

1. The following table is a classification of the number of people in thousands supported by agriculturists and actual workers in agriculture for the years 1910 and 1911. Find to the nearest integer the increase or decrease per cent in the figures for 1911 as compared with those of 1910 under each head.

Description	Supported by		Actual workers in	
	Agriculturists		agriculture	
	1910	1911	1910	1911
Non-cultivating land owners	34	30	23	19
Cultivating land owners	461	512	426	484
Non-cultivating tenants	6	2	4	1
Cultivating tenants	225	167	207	151
Farm labourers	279	284	340	345

2. On March 1, 1913, a person borrowed from A Rs 1,450 at 8% simple interest, and lent the sum on the same day to B at 8% compound interest, if both the transactions were closed on March 1, 1915, find his gain.

### 3. *Omitted, Stock and shares*

4. A school grants its games association Rs 216 a year, which is distributed among its three branches Tennis, Foot-Ball and Badminton, in the proportion of 14 : 6 : 1. The tennis branch is 14 strong and each member pays a subscription of Rs 2 per half year. If the branch pays Rs. 6 a month to the pickers and spends Rs 32 per annum on repairs to the court, find how many balls a month at Rs. 12 per dozen the branch can supply itself with so as not to work at a loss.

5. If a book-seller fixes his prices so as to include a profit of 30% on the cost price and offers a reduction of 10% on the published price for cash payments, find his gain per cent. If the cost price of 34 copies of a book be Rs. 50, what is his average gain per copy when all are sold for cash?

### 6. *Omitted, Sphere.*

7 A cast iron cylindrical weight is 18 in in diameter and has a slot 2 in wide and 10 in. long as in the figure, (*given in Ex. XII Q 36*) Find correct to 2 places of decimals, its thickness in inches when its weight is 100 lbs. (one cub. in of cast iron weighs 0.26 lb.)

8 The following table gives the power  $P$  lbs. to be applied in order to move the weight ( $W$  lbs) for a certain machine.

W	50	100	200	300	400	500
P	106	122	152	184	216	240

Draw a graph showing the relation between  $P$  and  $W$ , and find to the nearest integer the value of  $P$  when  $W=350$  and of  $W$  when  $P=158$ .

9 If a person buys ' $p$ ' dozen mangoes at ' $a$ ' as. per dozen and ' $q$ ' dozen mangoes at ' $b$ ' as. per dozen, and ' $r$ ' dozen mangoes at ' $c$ ' as. per dozen, and sells two-thirds of the whole lot at ' $d$ ' as. per dozen and the rest at  $\frac{1}{2}a$  annas per dozen, find the profit. If the profit is Rs. 4-6-0 when  $p=12$ ,  $q=5$ ,  $r=13$ ,  $a=20$ ,  $b=12$ ,  $c=10$ , find ' $d$ '.

10. Solve  $2x + 3y = 12$ ,  $0.5x - y = 4$ .

Compare your answer with the results obtained graphically.

11 Construct a quadrilateral ABCD having  $AB=AD=4$  cm.,  $AC=8$  cm. and  $CB=CD=6$  cm. Measure BD and the angles B and D.

12 Draw an equilateral triangle and a regular hexagon so as to lie between the same parallels and compare the areas of the two figures

## 1917

1 (1) The H.C.F. of three numbers is 7 and their L.C.M. is 12012. Two of the numbers are 364 and 84. Find the least value of the third number

You are given that  $461010 = 77 \times 5987\frac{1}{2}$ . Show how you can write down (correct to 5 places of decimals) the quotient when 0.046101 is divided by  $(14 \times 0.055 \times 0.001)$  without actually going through the ordinary process of division.

2 The following statement gives the figures under each head of contingent charges, both estimated and actual, for 1913—1914—

Items	Estimated			Actual		
	RS.	A.	P.	RS.	A.	P.
Printing	15,650	0	0	10,595	6	0
Stationery	12,550	0	0	6,610	2	0
Travelling expenses	10,630	0	0	12,939	7	0
Postal and other charges.	6,670	0	0	7,483	9	7

Items	Estimated			Actual		
	RS	A.	P.	RS.	A.	P.
Examination charges	3,450	0	0	3,362	10	1
Contribution to the library.	5,550	0	0	6,434	8	0
Cost of University Lectures	6,600	0	0	5,550	0	0
Total ..						

Fill in the row of totals and find by what percentage correct to one decimal place the total of actuals had fallen short of the total of estimated charges.

3. Two partners invest Rs. 2,700 and Rs. 1,500 respectively in their business and arrange that 40% of the profits should be divided equally between them and the remaining profits treated as interest on the capital. If one partner's share of the profits is Rs. 90 more than the other's share, what is the whole amount of the profits?

4. A man buys a field for Rs. 3,750 and lets it at a rent of Rs. 150 payable at the end of each year. The rent is invested at 5% compound interest per annum. At the close of 3 years he sells the field for Rs. 4,000 and draws out the accumulated rents and interest. Find the total he will have and the annual percentage (simple interest) he makes by the whole transaction.

5. A railway track starts from station A with a gradient of 1 in 200, i.e. a vertical rise of 1 yard in 200 yards measured along the track. The gradient remains the same for  $\frac{1}{2}$  mile and is followed by rising gradients of 1 in 150 for  $\frac{3}{4}$  mile, 1 in 120 for  $\frac{1}{2}$  mile, level for 1 mile and falling gradients of 1 in 110 for  $\frac{1}{2}$  mile, and 1 in 330 for  $\frac{1}{4}$  mile, when station B is reached. If station A is 179 feet above sea level, find, to the nearest foot, the elevation of station B.

6. The average heights of a man and a woman and their corresponding weights are given in the following table —

Height	5'0"	5'2"	5'4"	5'6"	5'8"	5'9"	5'10"	6'0"
Average weight of a man in pounds	..	126	139	145	155	162	169	178
Average weight of a woman in pounds.	103	112	126	139	152	156	..	..

Draw graphs in one and the same figure showing the relation between the average height and weight for each sex. Find from your graph the difference between the average heights of a man and a woman who each weigh 10 stones, and the difference in weight if they are each 5 ft. 6 $\frac{1}{2}$  in. in height.

**7. Omitted ; Sphere.**

**8.** A child is instructed as follows —“Think of a number double it, add 11 to the result, multiply the sum by 3, subtract 12, divide the remainder by 3, give me the answer.” Find a simple rule by which the number first thought of can be readily deduced from the answer given by the child.

**9** A and B engaged in play when A had lost Rs. 20, he had only one-third of the money which B had, but by continuing to play he not only won back his Rs. 20, but also Rs. 50 more with it and then found he possessed half as much again as B. With what sum did they respectively begin? Reduce the conditions of the problem to simultaneous equations in two unknowns and solve the problem.

**10** A is the centre of a circle of 5 cm. radius, and B is the centre of a circle of 2 cm. radius. CD is a direct common tangent to the two circles, and touches them at C and D respectively. If CD is 4 cm. long, find the distance between the centres. Draw a neat figure to scale.

**11** Divide a st. line AB 64 cm long, internally at X and externally at Y, in the ratio of 3 : 5. Verify the result of your construction by measuring the lengths of the segments.

Also show that they satisfy the formula  $2'AB = 1'AX - 1'AY$

**12** Show by a carefully drawn diagram how you will verify by paper cutting the truth of the proposition that the square on the hypotenuse is equal to the sum of the squares on the other two sides of a rt. angled triangle.

### 1918.

The fee income from the secondary department of a school in a certain month is given in the adjoining table

Find	Form	Strength.	Amount.	
			Rs.	As.
(1) The average fee paid by VI	VI	79	414	0
each boy in the whole department, and	V	80	404	4
	IV	78	383	8
(2) The percentage of the	III	76	240	9
I Form collections to the whole	II	74	191	3
income.	I	125	326	8

**2** A merchant bought at Narasapur 40 candies of paddy at Rs. 38 a candy and sent the same to Tanjore, paying Rs. 10 towards boat-hire as far as Nidadavole and 17 times as much for railway charges from there to Tanjore. His agent sold the whole quantity

at Tanjore at Rs. 2—4 as a kalam Find the amount of gain or loss to the Narasapur merchant, if he paid his agent a commission of 5% on the sale proceeds. 1 kalam = 24 Madras measures A candy = 800 seers, each of which is  $\frac{2}{3}$  of a Madras measure.

3. The following is a rough extract from a railway guide

*Trains from Madura.*

Distance from Madras in miles	Stations.	Boat mail to Ceylon
348	Madura <i>dep.</i>	11-45
448	Rameswaram <i>arr</i>	16-30

*Trains to Madura.*

Distance to Madras in miles.	Stations.	Boat mail from Ceylon	Rames- waram Express
448	Rameswaram <i>dep</i>	9-45	12-30
348	Madura <i>arr.</i>	14-30	19-30

Represent the motions of the three trains graphically. From the graph find when they are 40 miles from Madura and when and at what distance from Madura the Boat mail from Madura meets the other two trains (N. B.—Time is calculated for 24 hours from midnight to midnight)

4. On each page of an atlas the border lines are,  $7\frac{1}{2}$  in lengthwise and 6 in breadthwise The map of the Indian Empire is drawn to a scale of 300 miles to an inch and occupies  $\frac{1}{4}$  of the space within the border lines Find the area of the Empire in sq. miles On another page of the same atlas with similar border lines, there is the map of the Madras Presidency, whose area is 153,000 sq miles, excluding the native states occupying  $\frac{1}{7}$  of the space enclosed by the border lines. Find the scale to which this map is drawn

5. In the Post Office, War Loan Certificates were issued on the following terms —For a payment of Rs. 7—12—0 a certificate was issued which entitled the holder to get Rs 8—1—0, Rs 8—14—0 and Rs. 10, at the end of one, three and five years respectively What rate per annum simple interest does it come to in each of the three cases? Given also that the certificate holder was entitled to receive Rs. 8—7—0, and Rs. 9—6—0, at the end of 2 and 4 years respectively, show graphically how the money grows during the five years.

6. A cylindrical granary with a conical top is 14 ft. in diameter on the inside. The wall is 11 ft high, and the total height to the top is 14 ft. It was full of grain. Half of it was sold at Rs. 5—12—0 a bag and the other half at Rs. 5—4—0 a bag. Find the amount realized, given that a bag of grain measures 8.25 cub ft.

7. Describe a regular octagon on a straight line 2 cm long and find its area by any method

8. At a public examination in the Madras Presidency,  $x$  candidates who had taken Optional Mathematics scored in Elementary Mathematics an average of ' $m$ ' marks and the remaining ' $y$ ' candidates for the examination scored an average of ' $n$ ' marks. What was the Presidency average in the subject? If  $x=2,500$ ,  $y=6,428$ ,  $m=53$ ,  $n=30$ , find the Presidency average

9. A village postman attached to the Post Office at P has to go to 5 villages A, B, C, D & E and return to P. A is 5 miles due north of P, B, C and D are on the eastern side of the road from P to A, B is 8 miles from P and 6 miles from A, C and D are 5 and 6 miles respectively from P on a straight road PCD which is at rt angles to PB. E is 3 miles from P, its position being to the west of the road PA and the roads PE and AE being at rt angles to each other. Draw a diagram [scale 1 cm = 1 mile] and indicate the shortest route for the postman. What is the length of his circuit?

10 (1) Construct a quadrilateral ABCD, given that  $AB=3$  cm,  $DA=4$  cm,  $\angle A=120^\circ$ ,  $\angle C=70^\circ$ , and AB is parallel to CD. Measure BC

(2) The middle points of the sides of a scalene triangle are joined so as to form a new triangle. What fraction is this of the given triangle? Explain from a figure how your answer can be shown to be true experimentally by superposition

11. The distance from Madras to Ootacamund by railway is 358 miles, part of which is ordinary railway and the other part mountain railway. The second class fare over the former is 9 p per mile and over the latter is 9 p per mile. If the total fare be Rs. 18—10—6, find the length of the mountain railway.

12. A reservoir which supplies water to a town has two inlets whose diameters are 30 in and 16 in respectively, through which water pours in throughout day and night. Water is to be taken into the town through 6 pipes, all of uniform diameter. But they will remain open only from 5 a.m. to 9 p.m. daily. What should be the diameter of each of the latter, if the quantity conveyed to the town

every day is to be equal to the daily supply into the reservoir, assuming that the rate of flow is the same through all the 8 pipes?

## 1919

1. In form I of a certain school there are four divisions.

Division.	Strength	Total marks.	The adjoining table gives the
A	34	1372	strength and the total marks
B	35	1339	gained by the students of each
C	36	1489	division in a certain subject
D	37	1275	

Find, correct to one decimal place, the average mark for the whole form, and ascertain which division gets the highest average and which the lowest

2. A merchant cleared his goods by selling them at reduced prices. He sold certain goods whose catalogued sale price was Rs. 760 at a reduction of 15%, another set of goods whose sale price was Rs 880 at a reduction of  $12\frac{1}{2}\%$ , and the remaining goods whose sale price was Rs 480 at a reduction of 25%. He however gained in all 11% on his original cost price. Find the original cost price and also what percentage he would have gained had he not made any reduction in the catalogued sale prices

3. ABCD is a quadrilateral field in which  $AB=198$  yds,  $BC=264$  yds and  $AC=330$  yds. D is equidistant from A and C and at a distance of 214.5 yds from the diagonal AC. (1) Draw a plan of the field to a scale of 1 cm. = 33 yds (2) Find the area of the field in acres

4. See Exercise XXIX Question 14.

5. See Exercise VII Question 36.

6. (1) Show by a geometrical construction how a length which is  $\frac{1}{3}$  times a given length may be found.

(2) Describe a regular hexagon on a straight line 1.5 in. long and find its area

7. A stone road roller should be 4 ft. long, and should weigh 4 tons 8 cwt. What should be its diameter given that the weight of the stone is 441 lbs. per cubic foot?

8. There are some beggars consisting of men and boys. If the former be given 5 as. 6 ps. each and the latter 3 as. 6 ps. each a sum of Rs. 12—10 as. will be required. If each man is given 6 ps. less and each boy 6 ps. more, the total sum required is 2 as. less. Reduce the above conditions to equations and find the number of men and of

boys Represent the equations graphically and verify the result from the graph.

9 A garden is 240 yds. long and 180 yds. broad. A moat 5 yds wide and 2 yds deep is dug close to it on the outside all round, and the earth dug out is spread evenly over the garden. (1) Find in inches, correct to one decimal place, the height by which the level of the garden will be raised thereby.

(2) A certain contractor undertook to finish the work in 30 days and employed 36 men. At the end of 10 days only 1 ft. 6 in. of the depth of the moat had been dug all round. How many additional men should he employ from the 11th day to finish the work in the stipulated time?

10. A certain boy took a circular piece of card-board having a radius of 17.5 in. and made an angle of  $144^\circ$  at the centre. He then cut out and removed from it the sector piece containing the angle  $144^\circ$ , and made the bounding radii of the remaining piece coincide. What shape did he get? Calculate its height.

11 A merchant buys  $m$  maunds of coffee seeds at Rs.  $a$  per viss and  $n$  maunds at Rs.  $b$  per viss and mixes them. He sells the mixture at a uniform price and gains  $c\%$  on his total outlay. Find the selling price of each viss of the mixture.

If  $m=4$ ,  $n=5$ ,  $a=1\frac{1}{2}$ ,  $b=1\frac{1}{2}$ ,  $c=12\frac{1}{2}$ , find the selling price of the mixture per viss.

12 In a certain meadow there is a hut whose ground plan is a square each side of which is 28 ft. A cow is tethered to a post at one of its corners by a rope 35 ft long. Find the area that the cow has for grazing.

### Re-Examination 1919.

1 The strength of Form VI in a certain school is 105. The form average in Elementary Science was exactly 39 in a certain year. The boys scored marks thus in the subject—15 boys 54 marks each, 22 boys 45 marks each, 28 boys 38 marks each, 25 boys 33 marks each, and 13 boys 24 marks each. Of the remaining two boys A and B, A scored 20 marks more than B. How many marks did each of them get? Also find their rank.

2 A grocer wants to mix 80 lbs. of tea worth 15 as a lb. with some tea worth Re. 1-4-0 a lb., so that by selling the mixture at Re 1-3-0 a lb. he may gain 20% on his outlay. How many pounds of the superior sort should be taken to form the mixture?

3. In a 100-yards race A beats B by 20 yards and C by 8 yards. If B and C run over the same course of 100 yards, find who will win and by how many yards to the nearest integer. Verify the result graphically.

4. An open rectangular box is to be made out of a rectangular piece of card-board  $21\text{ in.} \times 10\frac{1}{2}\text{ in.}$  by cutting out 4 equal squares at the corners of the rectangle and folding up the 4 rectangles that result so as to form the vertical sides and the ends of the box. If the ends of the box are squares, find the cubical contents of the box. Draw a plan of the card-board to a scale of 1 cm. to 1 in., as it will look after the square corners are removed and before the rectangles are folded up. Also find the maximum number of such card-board boxes as can be packed in a cubical box whose edge on the inner side is 2 ft. 4 in. (The thickness of the card-board to be neglected throughout.)

5. According to the catalogue of a London firm the cost of the books that are to be bought for a High School in Madras is £ 60, of which 25% is marked net. In the case of the books so marked the packing is free. For the remaining books a discount of 20% is allowed, but £ 1—4—0 is charged for packing. The freight to Madras, for the whole consignment is £ 2-16 s. A Madras book-seller undertakes to supply the books marked net at Re. 1 a shilling and the rest at 14 as. a shilling. Which is more profitable, to get the books from London or to buy them in Madras, and by how many rupees? [current market rate £ 1 = Rs. 19]

6. Men, women and children are employed in a factory in the proportion of 1 : 2 : 3 and the wages of a man, a woman, and a child are as 6 : 3 : 2. When the number of men employed is 50, the total weekly wages of all the hands amount to £ 225. Find the weekly wages paid to a man, a woman and a child respectively.

7. Describe a quadrilateral ABCD with the following data —  $AB=8\frac{1}{2}\text{ cm.}$ ,  $BC=7\frac{1}{2}\text{ cm.}$ ,  $AC=6\text{ cm.}$ ,  $CD=5\text{ cm.}$  and  $\angle D=90^\circ$ . Find its area correct to two decimal places. If it represents a field drawn to a scale of 1 cm. = 30 yards, find the area of the field in sq. yds. correct to one decimal place.

8. A person borrows a certain sum of money at  $13\frac{1}{4}\%$  per annum simple interest promising to repay the amount at the end of 4 years and 6 months. But the loan had to be extended for a period of 1 year and 6 months more. Thereupon the creditor demanded not only that the

interests that had accumulated till then should be added to the principal but also the rates should be raised to 16% per annum for the period extended. On account of this the person had to pay Rs. 107-5-4 more than he would have paid had the sum continued at the simple interest for the whole period at the original rate. Find the sum borrowed.

9. The following tables give the population in thousands, of two towns A and B at the beginning of each of the years specified.—

Year.	1835	1845	1855	1865	1875	1880	1890
A	24.4	26	29.5	34	40	43	50
B	34	36	38.4	41.1	43	44.8	46.7

Draw graphs on the same diagram to represent the above, and estimate therefrom the population of each of the towns at the beginning of 1870. In which year was the population approximately the same in both towns, and what was it?

10. An Indian merchant arranged to buy tweed in France at 4.4 francs per metre. The cost of getting the same to India averages 0.1927 francs per metre. If he sells at Rs. 3 per yard, find his gain or loss per cent. [Re 1 = 1.68 francs, 1 metre = 1.0935 yards]

11. The length of a park is to its breadth as 4 : 3 and its area is 77 acres  $88\frac{3}{4}$  square yards. Find the length of its diagonal in yards.

12. To walk 1 mile A takes ' $m$ ' minutes and B ' $n$ ' minutes. (1) What distance does A walk more than B in one hour? (2) Find in terms of ' $m$ ' and ' $n$ ' what time A takes to walk 3 miles more than B. (3) Express to the nearest minute in what time A walks 3 miles more than B, when  $m = 16$  and  $n = 21$ .

## 1920

1. The sea-borne trade of the Madras Presidency for the year 1918-1919 shows that the value of foreign imports under 'Tobacco' raw and manufactured was Rx. 188, 652, for 1918-19, and Rx. 113,000 for 1917-18, the average for the preceding 4 years up to 1916-1917 inclusive being Rx. 49, 394. Find (1) the increase per cent in the value of imports in 1918-1919 over that in 1917-1918, and (2) by how many rupees the value of imports in 1918-1919 was in excess of the average value for the preceding 5 years, *i.e.* up to 1917-1918 inclusive. [1 Rx = Rs. 10.]

2. The cross-section of the canal running across the Godavari at the Gunnavaram Aqueduct is a trapezium 24 ft. at the top and 19 ft. at the bottom, the depth being 6 ft. If the slopes are of equal inclination, draw the cross-section to scale of 1 cm. = 2 ft. Measure

the angle at which the sides are inclined to the bottom of the canal. Given that the length of the aqueduct is 810 yds, find in cub. yds. the maximum quantity of water that can be contained in the whole length of the aqueduct and also in how many minutes a boat 15 yds. long and going down the canal at  $3\frac{1}{4}$  miles an hour will pass the aqueduct

**3** To find the height of a certain tower a surveyor fixes a pole vertically at a distance of 80 yds from it, the height of the pole above the ground being 15 ft. On going 5 yds. from the pole and away from the tower, he sees the tops of the pole and of the tower in the same straight line with his eye. Find the height of the tower, given that the height of his eye is 5 ft from the ground.

**4.** In the catalogue of a certain merchant the selling prices are given as shown in the accompanying table. He usually allows a discount of 5% on silks and 10% on checks

Owing to the war conditions he has raised his prices on all his goods by 20% but allows still the same rates of discount on the increased prices. A customer buys 6 yds of Tassur silk, 7 yds of Nugur silk, 3 yds. of Turban silk, 14 yds of Calicut check and 16 yds. of Holland check. What sum has he to pay the merchant ?	Goods	Price per yard
Tassur silk	Rs 4	11 0
Nugur silk	" 3	2 0
Turban silk	" 2	5 6
Calicut check	" 1	9 0
Holland check.	" 0	12 6

**5** A person bought two horses for different prices. By selling the first at a profit of 10% and the second at a profit of 15%, he gained 13% on the total cost price. Had he sold the first at a profit of 15% and the second at a profit of 10%, he would have got Rs 6 less on the whole. Find the cost price of each of the horses.

**6** A road runs from P to S passing through Q and R. PQ is  $10\frac{1}{2}$  miles and QR 7 miles. A starts from P at 6 a.m. and walks to S at a certain uniform rate, halting at Q for half an hour and at R for one hour. B starts from P at 7 a.m. on his cycle, his rate of cycling being 7 miles an hour. He passes A at 7.45 a.m. and goes on to R, where he stops for one hour. He returns to Q, where business detains him for an hour and a half. He then goes straight to S, which he reaches at 4 p.m. Find the distance from P to S, A's rate of walking, and the time when he reaches S. Represent the above graphically, and find from the graph when and where A and B will be together.

7. Describe an acute angled triangle ABC, given that  $AB = 3\frac{1}{2}$  in.,  $BC = 2\frac{1}{2}$  in. and  $\angle A = 50^\circ$ . Measure AC and the angle C. Find the area of the triangle in sq inches by any method. If it represents a field drawn to a scale of 1 in. = 1 furlong, find the area of the field in acre

8. When performing a certain experiment in Science the temperature at the end of 10, 20, 30, 40, 50 and 60 seconds was found to be  $15^\circ$ ,  $30^\circ$ ,  $43^\circ$ ,  $56^\circ$ ,  $58^\circ$ , and  $45^\circ$  respectively, it being observed also that  $60^\circ$  was the maximum reached. Draw a smooth curve, showing the changes in the temperature and find from it the temperature at the end of 25 seconds and also the time when the temperature was  $50^\circ$

9. If ' $m$ ' men can do  $\frac{1}{n}$  of a piece of work in  $p$  days, find an expression for the number of men required to do the whole work in  $q$  days. Find the number when  $m = 15$ ,  $n = 4$ ,  $p = 12\frac{1}{2}$  and  $q = 20$ .

10. When a certain weight was cast, it was found to weigh 184 lbs more than was intended. Thereupon a cube with an edge of 15 in. was scooped out from the bottom of it. But thereby the weight was diminished only by 108 lbs. It is proposed to diminish the rest by scooping out a cone with a bottom circumference of  $5\frac{1}{2}$  in. What should be the depth of the cone?

11. One litre of water weighs 1 kilogram, and one litre of pure milk 1.32 kg. A person bought 12 litres of milk and found it weighed only 12.288 kg. Find in cub. cm the quantity of water in the milk. (1 litre = 1 cubic decimetre.)

12. A War Savings Certificate costs 15 s. 6 d. and is worth at the end of the fifth year £1. After that period one penny is added to it every month and at the end of the tenth year from the commencement a bonus of 1s. is added to the total value of the Certificate. What rate of simple interest per annum does this work out for the whole period of 10 years?

Forty-eight English men employed in India saved each a sum of Rs. 2-8-4 daily from March 1st to September 2nd both inclusive, and with the total sum thus saved arranged to buy War Savings Certificates in England. How many certificates did they buy in all, and what total sum would they get in England by converting the certificates into cash at the end of 10 years after their purchase? [Re. 1 = 1s. 4 d.]

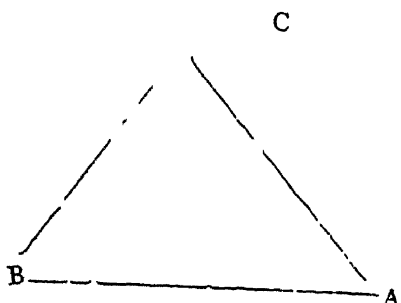
## 1921.

1. A metre is a ten millionth part of the arc of a meridian of the Earth from the Equator to the Pole. The earth's semi-circumference measured along a meridian is 10,800 nautical miles. Find the number of feet in a nautical mile, if one metre = 39'370 inches.

2. How far is the following statement correct?—Three measurements are necessary and sufficient to prepare an exact copy of a given triangle.

Measure the sides correct to the nearest tenth of an inch and the angles correct to the nearest degree of the given triangle ABC.

Construct a triangle PQR of the same shape as ABC but of perimeter 9'6 in. (*N. B.*—The data required for the construction of triangle PQR should all be obtained geometrically.)



3. AB is a diameter of a circle, whose centre is C. The circle is folded so that the points A & B are brought together at the centre C thus causing two creases. Show that the points A, B and the four ends of the two creases are the corners of a hexagon. Calculate the areas of the hexagon to the nearest hundredth of a square inch, if the radius of the circle is exactly 2'4 inches. Check by drawing an accurate figure.

4. Here is an extract from a statement of Educational Progress in the Madras Presidency for three years.

	1914-15	1915-16	1916-17
Total population	41, 404, 405	No change.	No change
Total Scholars in all Institutions	.. 1,542, 955	1, 615, 159	1,661,012
Grand total of expenditure in thousands of rupees..	19, 353	20, 652	21,688

Find from this statement (1) the ratio of the number of scholars to the total population for 1915-16 expressed as a percentage. (2) the increase per cent. in the number of scholars in 1916-17 over

that of 1914-15 and (3) the increase in the average expenditure per scholar for 1916-17 over that for 1914-15 Answer to the nearest anna

5. When sovereigns were selling at Rs. 18-12-0, a gentleman purchased a watch chain made of 12 sovereigns (including a wastage of  $6\frac{1}{2}$  per cent.). The making charges were 14 as per sovereign. A few days later he had to sell it, when the price of the sovereign fell to Rs. 16-4-0. The purchaser would take the chain on its net weight only, and would pay only 75 per cent of the making charges per sovereign on the net weight of the chain. What did the gentleman lose by the transaction?

6. A High School Co-operative Society was supplied by a Bombay Firm with Mathematical books at a discount of  $33\frac{1}{3}\%$  and History books at a discount of 40% off the published prices. Subsequently it was found that the Society would have paid  $2\frac{1}{2}\%$  of the published prices less, if all the books had been purchased from a Madras book-seller, who offered a uniform discount of  $37\frac{1}{2}\%$ . What percentage of the purchases, calculated at the published prices, was of Mathematical books?

7. The Secretary of a Chit Fund was authorized to buy a cash box. Every year of use was supposed to decrease the value of the box by  $12\frac{1}{2}\%$  of what it was worth at the beginning of that year. At the end of 2 years, the Fund was dissolved and the box was sold by auction for half its original value. By how much per cent. was this less than its value as calculated at the above rate of depreciation?

8. At the time of the German reverse (1914), a body of Germans began their retreat at the rate of 24 kilometres a day, from a place 36 kilometres distant from the Allies Battle Front. The Allies began their pursuit a day later at the rate of 32 kilometres a day. After three days' marching they were delayed in their pursuit for a day to construct a bridge across a river, they then continued their march for three days more and were again delayed for half a day to repair another bridge blown up by the enemy. After how many days from the beginning of the retreat were the Germans overtaken? Draw a graph to illustrate the movements of the armies. Find from the graph (1) how far the armies were apart seven days after the beginning of the retreat, (2) the time when the armies were 32 kilometres from one another.

9. A circus tent is in the form of a cylinder surmounted by cone. The cylindrical portion of the tent is of diameter 96 ft., the

height of the top of the tent is 36 ft. from the ground, and the height of the cylindrical part 16 ft. Find the total area of the canvas required for the tent. Answer to the nearest square foot. [ $\pi=3\cdot1416$ .]

10 The alloy of which the rupee is made consists of silver and copper melted together in the ratio of  $r$  : 1. The alloy is worth  $a$  rupees per lb. and pure silver  $s$  rupees per lb. Express the value of copper per lb. in terms of  $a$ ,  $s$  and  $r$ . What does copper cost per lb. if  $a=36\frac{3}{4}$ ,  $s=40$  and  $r=11$ ?

11. For an entertainment to be given to the Principal of a College on the eve of his transfer, the students of the B. A. classes agreed to raise among them a certain sum, levying a uniform rate of subscription. The Intermediate students joining them subsequently, the subscription per student was reduced in the ratio of 7 : 4 although the estimated expenses were increased by 50 per cent. Compare the strengths of the B. A. and Intermediate classes. From your result find the strength of the College, given that the number of students in the Intermediate classes was 182.

12. The following table gives a series of soundings (measures of depth) taken across a river 42 yards broad at a ford

Distance in yards from

a bank 0 5 8 10 14 16 19 23 26 30 32 35 38 42

Corresponding depth

in feet. 0 2'8 4'4 5'0 7'2 8'0 10'2 9'8 8'4 7'3 6'0 4'8 3'1 0

Draw a diagram to represent a section of the river at the ford. From it find (1) the probable depth in the middle of the stream, (1) how far a man who will be safe up to a depth of 5 ft. 2 inches can venture into the river from either bank without danger

### 1922.

1. Here is an extract from Indian Railway Statistics :—

Year.	Miles of State Railways.	Gross earnings in Rupees.
1903	21,131	36,00,82,035
1912	25,125	61,65,07,005

Calculate.—(1) The earning capacity of the Railways per mile in the two cases, correct to the nearest rupee. (2) The percentage of increase in that capacity for the period 1903-12, correct to the first decimal place.

2. Two persons standing at  $P$  and  $Q$  300 yards apart on a straight seashore, wish to find the distance of a boat  $B$  from the shore. They observe the angles  $BPQ$  and  $BQP$  to be  $50^\circ$  and  $70^\circ$  respectively. Obtain the distance of the boat from the shore.

3. Assuming that 15 cm = 5.9 in., draw a graph to convert inches into centimetres and *vice versa*. From the graph, get (1) the number of inches (to the nearest tenth) in (i) 4 cm, (ii) 10 cm. and (2) the number centimetres (to the nearest mm.) in (iii) 2.8 inches, (iv) 4.5 inches

4. The following is one of the rules of a Sangeetha Sabha.—

'Each member shall pay Rs. 1-4-0 every time he attends a performance or pay an advance annual subscription of Rs. 15 and also 10 annas at each performance'—(performances being weekly). A member  $X$  selects the first method of payment, and another member  $Y$  the second method. Both attend the performances regularly. After how many performances does  $Y$  gain an advantage over  $X$ ? Verify the solution of the question by drawing two graphs (in the same figure) to show the amounts paid by  $X$  and  $Y$ .

5 In connection with a street improvement scheme, a Municipal Corporation purchased the whole block of houses on one side of the street and the ground (708 ft.  $\times$  108 ft.) on which they stood. The houses alone cost Rs. 2,54,000, and the land cost Rs. 45 per *kuli*. (144 sq. ft.) The houses were pulled down and the materials auctioned away for Rs 95,000. The street (708 ft long) was then widened by 12 ft and the remaining land was sold at Rs. 185 per *kuli*. Find the net cost of the improvement scheme.

6 From a rectangular sheet of brass 32 in.  $\times$  20 in. a circular piece of diameter 20 in. is cut out and the remaining part is melted and beaten into a rectangular piece of the same shape as the original sheet and of the same thickness. Find its length and breadth to the nearest inch [ $\pi = 3.1416$ ]

7. Pure gold is said to be 24 carats fine. Mint gold contains 22 parts of pure gold to every 2 parts of alloy, and is hence said to be 22 carats fine. The gold nibs of Waterman Fountain pens are 14 carats fine. To make such nibs, 89 ounces of pure gold and 48 ounces of mint gold are melted together with a certain quantity of alloy. Find the quantity of alloy.

8 At a 'Grand Clearance Sale' a firm say that they have reduced their catalogue prices 20%, and also allow their customers 5% off their bills for immediate cash payments. If their profits even after such reductions on cash sales come to 14%, with what rate of profit in view were the original catalogue prices fixed?

9. I purchased a bungalow two years back for Rs. 50,000 and spent 10% of this sum to effect certain alterations and repairs. The

bungalow has remained unoccupied till now, and during this interval I reckon 5% per annum compound interest on my outlay. If I want to realize a profit of 20% on the total amount, at what price should I sell the bungalow now?

10. The owner of a lead mine collected 216'15 tons of stuff from which lead was to be extracted. It contained  $x\%$  of lead. After washing in which process no lead was lost, the stuff was found to contain  $y\%$  of lead.

show that  $\frac{y-x}{y}$  of 216'15 tons was washed away.

Find the quantity of lead obtained from the stuff, if  $x = 15.9$  and  $y = 87.45$

11. Draw a circle of radius

Names of Areas in miles to the nearest tenth of million	3 inches and divide it into six sectors whose areas are proportional to those of the six continents given in the adjoining tabular statement.
Asia 17'0	(1) Indicate in your figure the values of the angles of the sectors
Europe 3'8	to the nearest degree (2) Enter
Africa 11'4	neatly the names of the continents
Australia 3'0	in the corresponding sectors
North America 8'0	
South America 6'8	

12. Two cylindrical rollers of radii  $a$  ft. and  $b$  ft. lie side by side on a level ground, touching each other along their lengths. Express in terms of  $a$  and  $b$  the distance between the lines along which the rollers touch the ground. Find the distance if  $a = 2.25$  and  $b = 1.69$ .

### 1923.

1. The following statistics are taken from the Report on Public Instruction in Madras for 1920-21 —

Grants from Provincial funds to

Year.	Schools under private management.	Local Board Schools.	Municipal Schools.
	Rs.	Rs	Rs
1919-20 ..	40,54,293	33,39,703	6,53,466
1920-21 ..	42,96,756	34,61,324	4,31,880

Find—(1) the grand total of grants-in-aid in 1919-20 and 1920-21 —(2) the increase per cent. in grants for 1920-21 as compared with those for 1919-20 for Local Board Schools, (3) what percentage

the grants in 1920-21 for private institutions was of the total grant for the same year.

2. (1) If a piece of iron plate 21 metres long, 1'13 metres broad and 23 cm. thick weighs 425 kilograms, find to the nearest gram the weight of a square metre of sheet iron 2 mm. thick.

(2) Two cyclists start abreast at 3 o'clock to race on a circular track. If one goes round in 3 min. 12 sec. and the other in 3 min. 30 sec., find when they will again be riding abreast past the starting point. Find also the number of complete circuits they will then have made.

3 A tradesman marks certain goods 30% above cost price, he allows cash customers a discount of 12% and credit customers a discount of 5%, five-eighths of his goods thus marked are sold for cash and the rest on credit. When the whole stock has been sold and paid for, what is his percentage profit?

4 The Boy Scouts of a High School have a Savings Bank of their own and one of them had a balance of Rs. 6 at the Bank on the 1st January, 1922. At the beginning of February and of each alternate month following, he deposited Rs. 3. In the middle of April when the school closed, he withdrew Rs. 5 for his journey. If interest be allowed at  $6\frac{1}{4}\%$  per annum, what interest should be added to his account at the end of June 1922, each month being calculated as one-twelfth of a year?

5 A Railway contractor purchased 360 tons of cement at Rs.95 per ton two years before it was actually required and in conveying the cement from Madras to the nearest Railway Station, paid a railway freight of Rs 9-14-0 on each ton. The unloading and conveying charges amounted to 4 annas for a bag of cement. (10 bags of cement weighed one ton.) On the above outlay he reckoned 5% per annum C I. During the two years when the cement lay idle, he had to stock it in a building paying a rent of Rs 25 per mensem. When after two years the cement was wanted, he charged the Railway a higher rate and thus realized a profit of 60% on the total amount spent. Find, to the nearest rupee, the rate he charged for a ton.

6 A contractor employs 20 men working 8 hours a day in order to finish building a house in 25 days. At the end of 14 days only one-third of the work is finished. He engages more men and all this men now work 9 hours a day. What is the least number of additional men that he must engage if the work is to be done by the specified time?

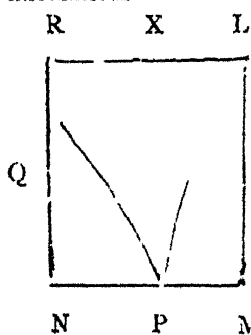
7. Two boys  $A$  and  $B$  had their heights measured on the first day of six consecutive years and their measurements are given below —

	1916	1917	1918	1919	1920	1921
A	3' 0"	3' 4 $\frac{1}{2}$ "	3' 7 $\frac{3}{4}$ "	3' 10 $\frac{3}{4}$ "	4' 1"	4' 2 $\frac{3}{4}$ "
B	3' 2"	3' 3 $\frac{1}{2}$ "	3' 5 $\frac{1}{4}$ "	3' 8 $\frac{1}{2}$ "	3' 11 $\frac{3}{4}$ "	4' 4"

Draw, on one diagram, graphs to illustrate their growth, and find the dates when they were of the same height.

8. If the speed of an aeroplane is  $v$  miles per hour, find its average speed from  $A$  to  $B$  and back, if the wind is blowing all the time from  $A$  to  $B$  at  $u$  miles an hour. Find the average speed of the aeroplane if  $v=60$  and  $u=5$ .

9. I stand on the road 6 feet from a lamp-post and notice that the end of my shadow just reaches a point at the foot of a wall. Find, by drawing to scale (1 cm = 1 ft), the distance of this point of the wall from the lamp-post, if the light is 10 ft above the ground, and my height is 5 ft. 6 in. Find this distance also by calculation.



10. In the accompanying figure  $LMNR$  is a rectangle, a quadrant of a circle is drawn with  $M$  as centre and  $ML$  as radius, meeting  $NM$  at  $P$ , another quadrant with  $N$  as centre and  $NP$  as radius meets  $RN$  at  $Q$ ,  $P$  being between  $N$  and  $M$ , and  $Q$  being between  $R$  and  $N$ . If the curved path  $LPQ$  from  $L$  to  $Q$  is 20 ft. less than the path  $LMNQ$  and 10 ft. less than the path  $LRQ$ , find the sides of the rectangle, [ $\pi=3\cdot1416$ .]

11. (a) Draw a right-angled triangle with equal sides and with hypotenuse equal to 2'3 inches. On the other side of the hypotenuse construct a square. Compare the area of the triangle with that of the square. (b) If the figure thus drawn represents the end view of a haystack whose breadth is  $b$  ft. and length  $l$  ft., what is the volume of the stack in cubic feet? Calculate the volume in cubic feet when  $b=20$  and  $l=50$ .

12. A boy fills with moist sand a cylindrical bucket which measures internally 12 in. in diameter and 16 in. in height. He empties the bucket and builds a conical mound with the sand on a base whose diameter is 18 in. Find the height and volume of the mound and the area of its curved surface.

## 1924

1 The following statistics taken from the census of 1921 give the population in thousands, of Hindus, Muhammadans and Christians in six districts —

	Population in thousands			Total.
	Hindus	Muhammadans	Christians	
Guntur (M)	1,514	131	153	
North Arcot	1,893	118	36	
Tanjore (M)	2,105	130	89	
Trichinopoly (M) ..	1,746	63	92	
Ramnad	1,521	116	85	
Tinnevely (M) ..	1,600	109	192	

(1) Find the total population for each district (horizontally) and for each community (vertically). (2) Express the Muhammadan population in each of the districts marked (M) as a percentage of the total population of that district correct to two significant figures, and state which of them has the highest percentage.

2. (1) Find, in pounds and ounces (correct to the nearest tenth of an ounce), the weight of a cubic foot of water, given that 1 metre = 39.371 in, 1 kilogram = 2.2046 lb. and 1 cubic metre of water weighs 1,000 kilograms

(2) A railway company increased its railway fare by one-half and again increased it by three-fourths of its new value. Find the original cost, to the nearest anna, of a ticket which after the two increases costs Rs. 19-4-0.

3. (a) The capital of a Co-operative Publishing House is fifteen thousand rupees, one-third of it is borrowed from a Bank at 6%, and the remainder is held in shares. The working expenses of the House are 40% of the gross receipts in a year. Find what the gross receipts must be in order to pay the shareholders 9% at the end of the year

(b) Three vessels, each capable of holding 32 gallons, contain mixtures of wine and water. In the first, which is half full, the quantities of wine and water are equal, in the second which is three-quarters full, there are 9 gallons of wine and in the third, which is full, there are only 4 gallons of wine. If the second is now filled up from the third, and then the first filled from the second, how many gallons of wine and water will be found in the first vessel?

4. For a certain football tournament, twelve teams (each consisting of six players) entered, paying an entrance fee of Rs. 10 each.

During each of the first four days of the tournament the spectators who numbered 500 on an average were charged 2 as. each, and on the fifth day, when the finals were played, the attendance was half as much again as on any previous day and tickets were sold at 4 as. each. The committee in charge spent 30% of the total income in fencing the ground, 25% of the remainder for ground-rent and Rs. 30—7—0 on miscellaneous charges. They further set apart Rs. 200 for Reserve Fund after purchasing a silver cup for the winning team and six silver medals for the runners-up, the cost of each medal being one-twelfth of that of the cup. Determine the cost of the cup and of a medal.

5. A dealer offers to sell a motor-car for Rs. 5,000 cash or for twelve monthly instalments of Rs. 500 each, the first being payable at once. Calculate the rate of simple interest charged on the supposition that the Rs. 5,000 invested at that rate for 11 months gives the same amount as the total of the amounts of the instalments invested at the same rate.

6. Among the elected members in a certain Legislative Council, the ratio of the ministers' party to the rest was 5 : 2. Eighteen members left the ministerial party and joined the opposition and consequently the ratio was reduced to 26 : 23. Find the total number of elected members.

7. The following table gives the time of sunrise and sunset at a certain place from July to December, 1923 —

Date	July 1.	July 15	Aug 1	Aug 15.	Sep. 1.	Sep 15	Oct 1.	Oct. 15.	Nov. 1	Nov 15	Dec 1	Dec. 15.	Dec. 31.
	H M	H M	H M	H M	H M	H M	H M	H M	H M	H M	H, M	H, M	H M
Sunrise	5 47	5 50	5 54	5 56	5 58	5 58	5 58	5 59	6 26	6 8	6 16	6 23	6 31
Sunset	6 39	6 39	6 36	6 31	6 21	6 12	6 05	5 51	5 44	5 39	5 40	5 45	5 53

(1) Plot graphs (in two different diagrams) showing for the given period (a) the time of sunrise, (b) the duration of sunshine, on successive days. (2) Deduce from the graphs the time of sunrise on November 22, and the duration of sunshine on August 8.

8. A man standing 12 yards from a river bank observes a post on the further bank directly opposite to him. He walks 30 yards parallel to the bank and then walks directly towards the post reaching the bank after walking 15 yards. Find by drawing to scale

(1 cm. to represent 3 yards), the breadth of the river, assuming the banks to be straight. Find the distance also by calculation.

9 A surveyor gives the following measurements of a quadrilateral field ABCD (having no re-entrant angle)  $AB=1,980$  links,  $BC=1,920$  links,  $AD=1,700$  links,  $\angle BAC=35^\circ$ ,  $\angle BAD=61^\circ$ , C and D being on the same side of AB. Draw a plan of the field to a scale of 1 in. for 400 links stating the steps of your construction. Find the area of the field in acres given  $100 \text{ links} = 22 \text{ yards}$ .

10. A shop-keeper uses a badly made balance so that a body really weighs  $a+b$  Q lb. when the balance shows only Q lb.,  $a$  and  $b$  being numbers which are the same for all weights. If the balance shows 1 lb for a real weight of 1.1 lb. and 2 lb. for real weight of 1.9 lb., what are the values of  $a$  and  $b$  and what will the balance show for a real weight of 2 lb.? Draw a graph to show the relation between the real weights and the weights shown by the balance.

11. A canal whose cross-section is a trapezium is 8 feet deep, 18 feet wide at the surface and 12 feet wide at the bottom. Find the area of the cross-section and the number of gallons of water that pass any spot in an hour when the canal is full and water flows at 2 miles per hour (Given one cubic foot of water = 6.25 gallons.)

12. A right circular cylindrical log of teak is 12 ft. long and of diameter 14 inches. Find its volume and curved surface. If it is planed down to the least amount necessary to form a prism whose cross-section is a regular hexagon, what would be the volume of the prism in cubic feet, given  $\pi = \frac{22}{7}$  and  $\sqrt{3} = 1.73$ . What percentage (correct to an integer) of the whole log would be wasted in planing down?

### 1925.

1. The following table shows the population in thousands of five Indian provinces according to the census taken in the years 1911 and 1921 :—

		Population in thousands.	
		1911	1921
Bengal	..	45,483	46,696
Madras	..	41,405	42,319
Bombay	..	19,626	19,348
United Provinces	..	46,807	45,376
Punjab	..	19,579	20,685

Find, correct to one decimal place (1) the percentage of increase or decrease of the population in each of the first three provinces (2) the percentage of increase in all the five provinces taken together.

2. Three men A, B and C, have together completed a piece of work for which they receive Rs 64—14—0. A has worked for 4 days of  $10\frac{1}{2}$  hours, B for 11 days of 7 hours, and C for 6 days of 9 hours. How much money ought each to receive?

3. A goldsmith undertook to make a jewel casket out of certain quantities of gold and silver, together weighing 104 ounces and costing £ 230—4—0. Instead of using the quantities of gold and silver agreed upon he interchanges them. If gold costs £ 3-17-6 and silver 5 s. 6 d. per ounce, find by how much the value of the casket has been reduced.

4. A clerk's salary was £ 80 for each of the first three years. Then it was raised at the rate of £ 10 a year for 12 years, after which it remained stationary. When he retired from work, he found that his average salary per year had been £ 174—10—0. How many years did he work?

5. Exactly three years ago a man borrowed Rs. 1,890 from a bank at  $6\frac{1}{2}\%$  per annum. At the end of a year he paid the interest for that year and a part of the loan, amounting altogether to Rs. 500. Similarly he paid Rs 700 at the end of the second year. What sum must he now pay to clear off the debt? (Answer to the nearest anna.)

6. Three cyclists, A, B and C ride round a circular track at 8, 9 and 10 miles per hour respectively. They start together from the same point, but C rides in an opposite direction to A and B, and meets A one minute after passing B. What is the length of the track?

7. If the manufacturer of a machine sells 36 machines to a wholesale dealer at 25% above cost price, and gives one extra machine free, and if the wholesale dealer sells each machine to a shopkeeper at 5% more than what it cost him, taking into account the machine given free and if the shopkeeper sells it to a customer for £ 34—13—0 making a profit of 10%, what did it cost to make?

8. A rectangular metal plate has a circular hole in it. The length of the plate is 1.3 metres, the width is 80 cm. and the thickness is 2 mm. If the plate weighs 32'25 lbs, find the diameter of the hole correct to a centimetre, given 1 c cm. of the metal weighs 8 grams and 1 lb. = 453'6 grams.

9. The following table shows the number of grams of alum which can be dissolved in 100 grams of water at different temperatures —

Temperature in

degrees C.

0° 10° 20° 30° 40° 50° 60° 70°

Grams soluble in

100 Grams of water. 3.9 9.5 15.1 22.0 30.9 44.1 60.6 90.7

Draw a graph and find at what temperature 50 grams of alum could be dissolved in 100 grams of water.

10. A straight rod AB, 2 ft, 8 in. long, is held under water, A being 2 ft. 6 in and B 1 ft. 2 in. below the surface. Find, by drawing to scale, the distance below the surface of a point C on the rod which divides AB so that  $AC = \frac{2}{3}BC$ . Find also the angle which the rod makes with the surface of the water.

11. The cost of making a certain machine consists of an initial expense plus a fixed sum for each machine. To make 25 machines costs £ 885 ; to make 40 machines costs £ 1,335 Find the initial expense and the fixed sum.

12. ABCD is a quadrilateral field in which the diagonals AC and BD are at right angles. AB, BC, CD and AC are 600, 700, 800 and 1,000 links respectively. Draw the quadrilateral to scale and hence find the area of the field in acres (100 links = 22 yards.)

13. A vessel in the form of a hollow right circular cone, whose height is 1 ft 6 in. and radius of the base 6 in., is placed with its axis vertical and vertex downwards. Find how many gallons of water it will hold (1 cub. ft. = 6.24 gallons). Find also the cost of tinning the inner surface of the vessel at 4 annas per sq. ft.

## 1926

### A.

1. The following table shows the values in lakhs of rupees of exports of merchandise from the Madras Presidency to some of the foreign countries during the years 1920-21, 1921-22 and 1922-23 —

	1920-21.	1921-22.	1922-23.
	Lakhs	Lakhs.	Lakhs.
(1) United Kingdom ..	839.77	613.96	824.11
(2) Other countries			
in British Empire	667.37	757.54	743.34
(3) France	151.06	426.14	519.67
(4) United States	92.59	105.14	150.08
(5) Belgium	137.97	108.08	121.24
(6) Germany	36.55	93.82	118.36

Find—

(1) the total value of the exports from Madras to all the countries during all the three years taken together,

(2) the percentage of increase or decrease between 1920-21 and 1922-23 in the case of each of the countries (1), (5) & (6).

2 A person going from one place to another travels 90 miles by steamer, 330 miles by rail and 30 miles by horse. If the journey occupies 30 hours 50 minutes and the rate of the train is three times that of the horse and one and a half times that of the steamer, find the rate of the train.

3 The external length, breadth and depth of a rectangular closed metal vessel are 14, 10 and 9 inches respectively, and the thickness of the metal half an inch. When the vessel is empty, it weighs 1,500 ounces and when filled with water 2,041.6 ounces. Find the weight of a cubic foot of water

4. Each railway passenger is allowed to take a certain weight of luggage free, and is charged for excess over that weight. Three passengers had to pay Rs  $1\frac{1}{2}$ , Rs. 3 and Rs. 4 respectively for 70 lbs., 100 lbs. and 120 lbs. Find graphically (a) what a passenger should pay for 145 lbs., (b) how much can be taken for Rs 6 and (c) what amount of luggage is allowed free for each passenger.

5. ABCD is a quadrilateral field such that  $AB=520$  links,  $BC=390$  links,  $CD=250$  links,  $DA=600$  links, and the angle  $ABC=90^\circ$ . Draw the quadrilateral to scale, and state what the distance AC is and what the angle CDA is. Find also the area of the field in acres correct to the second decimal place.

6. A rectangular sheet of drawing paper measures 15 cm. by 25 cm. It is rolled into a cylinder 15 cm. high, the two edges which meet being stuck together by stamp paper. How many c. cm of sand will the cylinder hold if it stood upright on a table?

## B

1. A and B became partners in a business and supplied £ 15,000 and £ 4,000 capital respectively. There was a profit, during the year, of £ 1,975, of which B as manager received 30 per cent. and A and B received the same greatest possible integral rate per cent. on their capitals which could be paid by the remainder of the profit. How much did each receive and what sum was left over?

2. When exchange was at 1 s. 8 d. per rupee a Madras merchant imported cloth for £ 500 at 6 s. 8 d. per yard. The cost of importation was 5 d per yard and the cost of landing and other charges 4 as. per

yard. One-fourth of the cloth, being damaged, was sold at a loss of 25 per cent. on its total cost to the merchant. At what price per yard did he sell the remainder if he gained 20 per cent. on the total outlay?

3. A man had two creditors, his debt to the one being double his debt to the other. After paying his larger creditor 4 s. in the £ and the other creditor in full, he had £ 10 left. If he had divided all his estate fairly between them, each would have got 10 s. in the £. What was the value of the estate and how much did he owe each of his creditors?

4. A bath can be filled by the cold water pipe in 9 minutes and by the hot water pipe in  $11\frac{1}{4}$  minutes. A person leaves the bath room after turning on both pipes simultaneously and returns at the moment when the bath should be full. Finding, however, that the waste pipe has been open he now closes it. In  $3\frac{3}{4}$  minutes after this the bath is full. In what time would the waste pipe empty it?

5. At a certain election the number of votes received by A was to that received by B as 19 : 16. At a subsequent contest between the same candidates the entire number of votes polled increased by 450, and the excess of A's votes over B's was 270 more than in the former contest. If, at the second election, the number of votes received by A was  $\frac{3}{4}$  of that received by B, find the number of votes received by each candidate at each election.

6. A man buys a house on condition that he should pay £ 625 now, £ 625 at the end of the first year and £ 625 at the end of the second year. Calculating compound interest at  $5\frac{1}{2}$  per cent. per annum what value to the nearest shilling has been put on the house.

### 1927.

#### A

1. The population of a city is 155,625. There are 1,075 females to every 1,000 males. Among the males 12 per cent. are literate and among the females 4 per cent. are literate. Find what per cent. of the total population are literates.

2. At the last Secondary School-Leaving Certificate Public Examination 'a' candidates answered the English papers and the average per cent. of marks that they obtained in that subject was 'x'. Of these 'b' candidates were from the Andhra University area and the average that they obtained in that subject was 'y' per cent. Find z, the average per cent. obtained by the others.

If  $a=15,345$ ,  $b=7,375$ ,  $x=34$  and  $y=35$ , find  $z$

3. If the difference between the simple and compound interest on a certain sum for 3 years at 5 per cent. is Rs. 7-10-0, find the sum

4. In a club there are 200 members who pay a total annual subscription of Rs. 4,400. Of these some are active members who pay an annual subscription of Rs. 25 each, and the others are associate members who pay an annual subscription of Rs. 15 each. Find how many members there are in each class.

5. A left Madras at 4 A.M. on a certain day and began walking westwards at 3 miles an hour. B left the same place at 6 A.M. on the same day cycling in the same direction at 6 miles an hour. Find graphically when and where B will overtake A

6. Construct a quadrilateral ABCD, of which two sides AB and BC 11 and 24 inches long respectively contain an angle of  $130^\circ$  and the other two sides CD and AD are of lengths 25 and 3 inches respectively. Find the area of the figure

### B

7. A and B can do a piece of work in 15 days, while B and C do the same work in 18 days and C and A in 20 days. They are paid according to the amount of work that each of them turns out in a day. If C's daily wages are 14 annas, find how much A and how much B receives in a day

8. A merchant mixes two kinds of coffee, which cost him Rs. 2 a viss and Rs. 3-12-0 a viss respectively, and sells the mixture at Rs. 3 a viss, thereby gaining 20 per cent. on his outlay. Find the proportion in which the two kinds have been mixed.

9. A field 4 acres in area has to be irrigated to a uniform depth of an inch. An 8 inch diameter pipe running full with a velocity of  $2\frac{1}{2}$  feet per second carries water to the field from a channel. How long will it take to irrigate the field?

10. A man performs his journey partly by rail and partly by river the former at 3 pies per mile and the latter at 6 pies per mile, the fare amounts to Rs. 3-12-0. But if the rate of the former be reduced by  $\frac{1}{2}$  pie per mile and the latter increased by one pie per mile, the fare is increased by 5 annas. Find the distances travelled by rail and river respectively.

11. A man has two plots of ground, one a square whose side is 3,564 yards long, and the other a rectangle 1,628 yards long and

891 yards broad. He exchanges them for a single square plot of the same area. Find the length of a side of the new plot and the cost of fencing it all round at 2 annas per yard.

**12** A man 6 feet high standing due east of a street electric light and at a distance of 54 feet from it observes that his shadow is 18 feet long. Find from a plan drawn to scale the height of the light from the ground and verify your result by calculation. How much further east must he go so that his shadow may be 24 feet long?

### 1928.

#### A

**1.** Boys and girls of school-going age form 28 per cent. of the population of a taluk which is 3,55,000. There are 72 girls of the school-going age for every 68 boys of that age. Of the boys 55 per cent. and of the girls 35 per cent. are at school. Find what per cent. of the total population are at school.

**2** A hostel consists of two blocks of rooms. There are  $a$  rooms in the western block of which two rooms are used as kitchen and dining rooms, the other rooms being occupied by  $b$  students. In the eastern block there are  $c$  rooms of which one room is used as a general reading room, the other rooms being occupied by  $d$  students. Each room in the western block is let at Rs. 3 and each room in the eastern block at Rs. 4. If Rs.  $e$  is the average rent paid by a student in the hostel, connect  $a$ ,  $b$ ,  $c$  and  $d$  with  $e$  by an equation. From the equation find the value of  $e$ , if  $a=15$ ,  $b=18$ ,  $c=16$  and  $d=15$ .

**3.** What sum lent out at compound interest for 3 years at 5 per cent. will amount to Rs. 1,736-7-0?

**4.** A man performs a journey of 212 miles partly by river and partly by rail, the former at 2 annas 6 pies per mile and the latter at 1 anna 2 pies per mile. The total fare amounted to Rs. 21-2-0. Find the distance travelled by river.

**5.** On a base of 1.5 inches describe a regular hexagon and determine its area.

#### B

**6** A certain piece of work can be done by 40 men in 60 days. Find the difference in cost if 10 men and 30 boys were employed instead of 40 men, if 3 boys can do as much as 2 men, and the wages of a man is 10 annas, and of a boy 5 annas, a day.

7. The length of a rectangular field is three times its breadth. The area of the field is 36·3 acres. Find the cost of fencing it all round at 2 annas a yard.

8. A merchant bought in Tinnevely 160 bags of rice at Rs 10 a bag of 140 lb and sent them by rail to Chidambaram, a distance of 320 miles at 6 pies per mile per ton. During the transit 8 lb. of rice were stolen from each bag. He sold the remainder at 3 measures per rupee. Find his profit per cent (1 measure =  $3\frac{1}{2}$  lb.)

9. There is a huge cylindrical reservoir where water is stored for 7,700 persons for 3 days at 6 gallons per head per day. Find the height of water in the reservoir if its diameter is 42 feet. 1 cubic foot of water =  $6\frac{1}{4}$  gallons.

10. A cyclist left A at 4 A.M. and rode towards B a distance of 36 miles at the rate of 8 miles an hour. After riding for 2 hours he spent half an hour to do certain repairs and afterwards was able to ride at 5 miles an hour. Find graphically when he would reach B. Just as he reached B, his friend who had left A for the same place and was riding uniformly at 9 miles an hour also reached the place. Find graphically when the latter left A.

### 1929

1. (i) Given that a metre is 39·37079 inches, find to the nearest yard the difference between 5 miles and 8 kilometres.

(ii) A Bombay merchant owes Rs 1,410 to a merchant in Berlin and remits it to him through London. If the exchange between Bombay and London is 1 s. 6 d. for a rupee and that between London and Berlin is 1 mark for  $11\frac{3}{4}$  d., what does the German merchant receive?

2. (i) Use the formula  $(a+b)(a-b) = a^2 - b^2$  to simplify  
 $816 \times 784 - 576 \times 624$ .

(ii) A dealer buys  $x$  viss of ghee at  $m$  rupees per viss, and mixes with it  $y$  viss of cocogem, which he buys at  $n$  rupees per viss. He sells the mixture at  $p$  rupees per viss. If, in selling the mixture, he uses a false balance by which a substance appears to weigh  $1\frac{1}{2}$  times its actual weight, find what profit he makes. If  $x = 2$ ,  $m = 3\frac{1}{2}$ ,  $y = 5$ ,  $n = 1\frac{1}{2}$  and  $p = 3$ , calculate the profit.

3. In 11 days 250 men working 9 hours a day construct 528 yards of a road which is to be  $1\frac{1}{2}$  miles long. How many additional men must be employed in order that, if all now work 10 hours a day, the road may be finished in 33 days more?

4. A man pays  $5\frac{1}{2}\%$  of his gross income as life-insurance premium, and on the remainder he pays income-tax at 5 pies in the rupee. If his net income is Rs. 4,233-12-9, find his gross income.

5. Construct a quadrilateral  $ABCD$ , in which  $AB = 3.7$  in.,  $BC = 3.2$  in.,  $DA = 1.3$  in.,  $BD = 4$  in., and the angle  $BCD = 90^\circ$ . Find its area.

6. A certain sum of money lent out at compound interest amounts to Rs. 275-10-0 in two years, and to Rs. 289-6-6 in three years. Find the rate of interest, and the sum lent

7. A square plot of ground occupying  $6\frac{1}{4}$  acres is bordered on the outside by a path which is  $2\frac{1}{2}$  yards wide. Find the cost of gravelling the path at 3 annas per square yard.

8. A man sells two horses for Rs. 400 each. He gains  $10\%$  on one horse and loses  $10\%$  on the other. What is his gain or loss per cent. on the whole?

9. A tent is in the form of a right circular cylinder surmounted by a cone. The diameter of the cylindrical portion is 24 ft. The height from the ground to the vertex of the cone is 16 ft., while the height of the cylindrical part is 11 ft. Find the cost of the canvas required for the tent at 12 annas per sq. yd. [Take  $\pi = 3\frac{1}{7}$ ] (cf. Ex. XVI Q 17)

10. A ladder  $32\frac{1}{2}$  ft long leans against a vertical wall, and the foot of the ladder is 8 ft. from the wall. How far from the ground is a man two thirds of the way up the ladder?

11.  $P$  and  $Q$  are two towns 60 miles apart.  $A$  rides from  $P$  to  $Q$  starting at 1 p.m.,  $B$  leaves  $Q$  at 1-36 p.m. and rides towards  $P$ . If they meet at 4 p.m. and  $A$  reaches  $Q$  at 6 p.m., find graphically (i) when  $B$  arrives at  $P$ , (ii) when  $A$  and  $B$  are 22 miles apart, (iii) where  $B$  is when  $A$  is half-way between  $P$  and  $Q$ .

12. A train travelling at the rate of 50 miles an hour passes a cyclist going in the same direction on a road parallel to the railway in 6 seconds. If the cyclist had been going in the opposite direction, the train would have passed him in 4 seconds. Find the length of the train.

## COLLECTION OF FORMULAE.

### 1. Right-angled triangles.

1.  $c^2 = a^2 + b^2$  where  $c$  is the hypotenuse.

2. Diagonal of a square = side  $\times \sqrt{2}$ .

**2. Triangles.**

1. Area of any  $\Delta = \frac{1}{2} \times \text{base} \times \text{altitude} = \sqrt{s(s-a)(s-b)(s-c)}$
2. Area of a right angled  $\Delta = \frac{1}{2} ab$ .
3. Area of an equilateral  $\Delta = \frac{\sqrt{3}}{4} a^2$  ( $\text{side} = a$ )

**3. Quadrilaterals.**

1. Area of any quad  $= \frac{1}{2} (\text{diagonal}) \times (\text{sum of the offsets})$ .
2. Area of a Trapezium  $= \frac{1}{2} (\text{height}) \times (\text{sum of } \parallel \text{ sides.})$
3. Area of a Parallelogram  $= \text{base} \times \text{height}$
4. Area of a Rhombus  $= \frac{1}{2} (\text{product of diagonals})$

**4. Circles**

1. Circumference of a circle  $= 2\pi r$ .
2. Area of a circle  $= \pi r^2$ .

**5. Area of a ring  $= \pi (a^2 - b^2) = \pi (a+b)(a-b)$ .****6. Sectors.**

Length of the arc  $= D/360 \times \text{circumference of circle}$  ( $D = \text{central angle}$ ).

Area of a sector  $= D/360 \times \text{area of a circle} = \frac{1}{2} \text{arc} \times \text{radius}$ .

**7. Segment of Circles** Area of a segment  $= \text{sector} - \text{triangle}$ 

**8**  $a^2 + h^2 = b^2 = 2rh$  where  $r$  is the radius of the circle,  $2a$  the chord of the arc,  $h$  the height of the arc and  $b$  the chord of half the arc. Length of the arc  $= \frac{8b-2a}{3}$

**9. Regular Polygons.**

Area of a regular polygon  $= \frac{n}{2} \times \text{side} \times \text{perp. from centre}$ .

Area of a regular hexagon  $= 6 \times \frac{\sqrt{3}}{4} \times a^2$  ( $\text{side} = a$ )

Area of a regular octagon  $= 2(\sqrt{2} + 1) a^2$  ( $\text{side} = a$ ).

**10. Rectangular Solids and cubes**

1. Surface of a rectangular solid  $= 2(ab + bc + ca)$
2. Surface of a cube  $= 6a^2$
3. Volume of a rectangular solid  $= abc$ .
4. Volume of a cube  $= (\text{Edge})^3$ .
5. Diagonal of a rec. solid  $= \sqrt{a^2 + b^2 + c^2}$ .
6. Diagonal of a cube  $= \sqrt{3} \times a$ .

**11. Prisms.**

1. Lateral surface  $= \text{perimeter of the base} \times \text{height}$
2. Volume  $= \text{area of the base} \times \text{height}$ .

**12 Right Circular Cylinders.**

1. Curved surface  $= 2\pi rh$ .
2. Volume of a cylinder  $= \pi r^2 h$ .

**13. Pyramids**

1. Slant surface  $= \frac{1}{2}(\text{perimeter of the base}) \times \text{slant height}$ .
2. Volume  $= \frac{1}{3}(\text{area of the base}) \times \text{height}$ .

**14. Right Circular Cones.**

1. Curved surface  $= \pi rl$ . ( $l = \text{slant height}$ )
2. Volume  $= \frac{1}{3}\pi r^2 h$ . ( $h = \text{vertical height}$ )
3.  $l^2 = r^2 + h^2$ .

**General Instructions.**

**General.** Be *slow* and *careful* in reading the question paper and the notes given at the top of the paper. Attempt the easier questions first. When you take a question to be worked, read it twice or thrice till you understand it. Underline the specific instructions (*e.g.*, find *to the nearest anna*) and phrases (*e.g.*, interest being payable *half yearly*) that you are likely to lose sight of. Analyse the question and chalk out in your mind the different steps by which the final result is to be obtained. Then write down neatly the steps one after another taking care to copy the numbers correctly. Never write one number over the other. Strike off the wrong one and write the correct one above it. At every stage of the working, check the result obtained by rough estimates. After the completion of the solution, see if the answer got is possible. Avoid giving absurdly wrong answers (*e.g.*, the depth of a river is 34 miles). Finally take care to express the result in the required form correct to the required degree of approximation.

**Rough Work** If you have to write on both sides, rule off the lower half of the page for rough work. Rough work does not mean scribbling. The several steps by which the final result is obtained constitute 'fair work' and all calculations (*e.g.*, processes of division, multiplication, reduction, extraction of square root, etc.) form the rough work and should be written below so that the main steps above may stand prominent. Do the rough work *neatly* and *carefully* to facilitate revision and valuation by the examiner. If you are asked to write on one page only, do not leave the first page of the answer book blank.

Use the back of the outside printed cover for rough work. Remember that the 'way' is as important as the final result, if not more.

All answers in money should always be, unless otherwise required, in Rs. A. P. or £. *s. d.* to the nearest pie or penny as the case may be. In the result Rs. 72—5—3½, ½ pie has no practical existence.

Never carry the decimal of a rupee or sovereign to more than four places. Any figure in the fifth place does not at all affect the result.

All answers involving fractions not of a simple nature (e.g.,  $\frac{1}{2}, \frac{1}{3}, \frac{2}{3}, \frac{1}{4}$ , etc.) should always be, unless otherwise required, in decimal, correct to one place. Fractions like  $\frac{1}{17}, \frac{1}{23}$ , should be avoided.

Reserve all simplifications for the last step. Much time and labour can be saved by doing so. Sometimes the result, if simplified at each step, is not as elegant and neat, as it would otherwise be.

If you are asked to give the result to the nearest rupee or integer, the fractions should not be simplified at every step and the interim results should not be reduced to the nearest rupee or integer. If you do so, the final result will not be correct to the nearest rupee or integer. The simplification should be done at the end, and the result then obtained should be corrected to the nearest rupee or integer.

If a result is required to a certain number of figures, retain in general two more figures in the course of the working.

The habit of verifying the answers at least in the case of questions admitting of easy verification should be systematically cultivated.

When the sign of equality is used a number of times in the same line, see whether the two expressions on both sides of every sign of equality are equal. If this principle is understood, the mistake in the following statement will be obvious.

$$\frac{1}{2} \text{ of } 8 = 4 + 12 = 16 - 1 = 15 - 3 = 5 \times 7 = 35.$$

**Equations.** All letters used in Algebra stand for numbers and not for numbers of things. Hence it is wrong to say  $x = 5$  men, let his income be  $x$ . You should say  $x = 5$ , let his income be £

When you begin to solve an equation, start by copying down the equation exactly as it is given. Do not make any simplification in your head. The sign  $=$  should not be used between two equations to show that one follows from the other. It is wrong to write  $4x = 20$   
 $= x = 5.$

The correct way to write is  $4x = 20$ .

$$x = 5.$$

Substitute the value of the unknown letter in the equation just as it is given and not in its simplified form. Only by substituting it in the very first line, you can make sure that there is no mistake in the working.

When you verify the result, substitute the value of the unknown letter in each side *separately*. First find the value of the left hand side by itself. After finishing that find the value of the right hand side. *Never simplify the two sides together.*

In solving problems state clearly what the unknown letters represent

In forming an equation connecting quantities different denominations should not be mixed up e. g., 8 annas + 2 (12—1) annas = Rs. 9-2 as.

In checking the result, substitute it not in the equation, but in the *problem* itself

Sometimes in solving questions on time and distance a diagram may be drawn and the data noted in it

$\pi$  — Unless otherwise stated  $\pi$  should be taken as being equal to 3.1416. It is sometimes useful to substitute the value of  $\pi$  at the very end (e. g., S. S. L. C., 1919, Q. 10)

**Percentage.** Note — (1) Gain or loss per cent is calculated on the cost price, while discount or commission is always allowed on the marked or the catalogue price (2) Percentage is a *ratio*

**Square Root** In extracting the square root of a fraction proper or improper, the easiest method in many cases is to convert it into a decimal and then to extract the root

**Practical Geometry** Draw the figures *neatly* and *carefully* with correct instruments and well mended *black lead pencils*. Note the measurements in the figure. Don't rub out the construction lines. The construction should invariably be *stated*. In all cases where triangles and quadrilaterals have to be constructed from given data, it is advisable to make a rough sketch of the figure to be drawn showing the given measurements. This will very often suggest the method of procedure. In such cases the angular points must be named in order. In drawing plans of fields the actual lengths of the sides should be noted along them. The answers should not be left as so many units of length used in drawing the figure e. g., 2.5 in.

The plans drawn should be true to life. For example the section of a canal should have the longer of the parallel sides at the top and not at the bottom while a section of the railway road should have the longer of the parallel sides at the bottom and not at the top. Choose a suitable scale so that the fig. is neither too big nor too small. A scale always means a linear scale. "1 sq in = 14,400 sq miles is absurd. *Note the scale very near the figure*

The figure and the construction should be on the same page for easy reference. So begin the question at the top of a page

Don't draw the figures on graph sheet, for they cannot be so neat thereon as on blank sheets. But the sheets may be used for drawing the figures of the theorems corresponding to the algebraical identities

Before measuring an angle, see whether it is acute, or obtuse. Then measure it. Thus you can avoid the mistake of writing the value of the supplementary angle. Before measuring straight lines estimate their lengths.

In finding the area of a triangle it is better to apply the formula area of a triangle =  $\frac{1}{2}$  base  $\times$  altitude instead of the cumbrous one

$$\frac{1}{4} \sqrt{(s-a)(s-b)(s-c)}$$

**Graphs. 1.** Draw the two axes  $OX^1$  &  $OY^1$  neatly and carefully and name them correctly.

**2.** Mark the origin  $O$  and its co-ordinates. It need not always be  $(0, 0)$ .

**3.** Choose a *convenient* scale taking into consideration the lengths of the axes and the magnitude of the quantities to be represented. The scale chosen should be neither too small nor too big, but should be consistent with the size of the paper so that the graph may occupy the central portion of the page

**4** Note down the scale on the graph page

**5** Graduate the axes neatly. It is not necessary that numbers should be entered by the side of *all* divisions.

**6.** The results arrived at by graphical work should be noted down on the graph page.

**7** In the graphical solution of Simultaneous Equations—

*a.* The graduations along  $OX^1$  &  $OY^1$  should have the negative sign prefixed to them.

*b.* The axes should be drawn in such a manner as to give more space to the quadrant in which the two straight lines cut.

c. Only three points should be plotted to draw the graph of a linear equation, but the points should be as distant as possible from one another

d. The equation should be written along the straight line *immediately* after drawing it

e. The Co-ordinates of the point of intersection of the straight lines should be noted on the graph page.

f. The Co-ordinates of the points plotted should be entered neatly near them

g. The equation should be written by the side of the table of values

h. If the three points do not lie in one and the same st line see whether the Co-ordinates of the points chosen satisfy the given equation and whether the points have been correctly plotted Do not rashly attribute the mistake to the graph paper.

Since the result obtained by the graphical solution cannot be identical with that obtained by the theoretical solution in all cases but can only be approximately equal to it, give the results actually got from the graph But see that the difference between the two is not great

In drawing straight lines which should be uniformly thin use the foot-rule and not the six-inch-scale which may not be long enough The straight line should be drawn once for all to avoid some portion of it becoming thick.

9 Graph sheets should be pinned in such a manner that the graph may face the page on which the readings and any working relating thereto may have been entered.

10. Nothing should be written on the back of the graph paper.

11. In statistical graphs which admit of interpolation the graph should be a *smooth and continuous curve* and not straight lines formed by joining the points plotted

---

## Answers

**Ex I.—**1 180 2 50 ft. 3 Rs 24,000 Rs. 12,000. 4 40 mls.  
 5 25 mls. 6. 12 mls. 7 20, 40 & 60. 8 12. 9. 15, 45 & 150.  
 10 240 mls. 11. Rs. 75, Rs 225 & Rs 600. 12. Rs 10, Rs. 25 &  
 Rs. 15 13. Rs 80, Rs. 92 & Rs. 100 14 660 & 880 15 40. 16.  
 140 17 40·5 mls 18 10 & 45. 19. 20, 40 & 80. 20 60. 21.  
 26, 12 & 18 22 23 cub in. 23. 81 & 64 gms 24 36 & 48.  
 25 60 26 120 & 80. 27. 69 28. 5 viss. 29. 8 bags. 30 28  
 mrs 31 72 lb. 32 60 & 72. 33. 10 34 13. 35 36 & 12.  
 36. 24 & 60 37 Rs 96 & Rs 64 38. Rs 5,100. 39 Rs. 5,250.  
 40 Rs 25 41. 680. 42 Rs 65 & Rs 100. 43 Rs. 595 & Rs. 405.  
 44. 30 ft. × 24 ft. 45 6 ft 46 30 ft 47 24 ft 48 £4,680,  
 £4,720. 49. 2,080. 50 Rs. +25. 51 8 & 6%. 52 5 & 6 yrs. 53.  
 Rs. 250. 54. Rs 200 & 220. 55 Rs. 300 at 3% & Rs. 60 at 5%.  
 56 Rs 9,120. 57. 57 58 2. 59 40. 60. Rs. 20. 61 3 62.  
 Rs. 2-12. 63. Rs. 1,996 & Rs. 2,000 64 32 viss. 65. 12 & 8  
 mls. 66. 14 mls. 67. 14 mls. 68. 27 mls

**Ex. II.—**1 41·8% 2 21·5 3. 15,300 4. 36, 44 & 56 5.  
 164. 6. 240, 30 & 78 7 76·2%, 149%. 8. 10 tons 9 20·7%,  
 24·3% & 55·0%. 10. 11,000 11 25 acres 12 35,000. 13 18,500  
 14. 26·5 per 1,000 15. 161 per 1000. 16. 200 & 90. 17 Rs. 17  
 8 as. 18. Rs 2,400 19. 9·2%. 20 £ 145,557,151 ; 18·23%. 21.  
 Rs. 117,000 22 Rs. 13333-5-4 23 400. 24 50·6% at A, 33·3%  
 at D. 25 72·7% 26 9·75%. 27. £ 151. 28 72·1% 29 80.  
 30. 10 viss. 31. 62·5 % & 7·7%. 32. 54·2, 35·2, 10·6 & 5·5%

**Ex III.—**1. 53·3. 2. 19 yrs. 10 mths 3. 124½ lbs 4. 1349  
 lbs. 5. 552, 11·0 % 6. 1,250 7. 3,000 8 5·5%. 9. 11½% 10  
 69 boys (nearly) & 63 girls 11 102·7°. 12 Rs. 370. 13 13 st. 4  
 lbs. 14. 23·37, 25·87, 25·70, 28·54, 33·34 & 26·98 in. 15. A=P—  
 P/40 (b-30) where P is the full pension, b the age and A the pension ,  
 Rs. 165-0-7 nearly 16 14 yrs 8 months 24 days. 17. Rs. 177-14-8.

**Ex. IV.—**1. 7·5%. 2. Rs. 69. 3. Rs 3,270. 4 7%. 5. 12%.  
 6. 15%. 7. 13½%. 8. 12%. 9. 1 yr and 8 mths, 1 yr. & 4 mths  
 10 10 mths. 11. 2 yrs. 6 mths. 12. 3 yrs. 13. 6 yrs. 14 Rs. 2,400.  
 15. £ 22-2-9. 16. Rs 842. 17. Rs. 7-8.

**Ex. Va.**—1.  $x=6\frac{3}{4}$ ,  $y=2\frac{1}{4}$ . 2.  $v=6$ ,  $v=-2$ . 3.  $a=3$ ,  $y=1$ . 4.  $a=5$ ,  $y=2$ . 5.  $x=3$ ,  $y=-5$ . 6.  $x=3$ ,  $y=2$ . 7.  $a=4$ ,  $v=1$ . 8.  $v=8$ ,  $y=1$ . 9.  $x=-3$ ,  $y=-6$ . 10.  $a=2$ ,  $y=3$ . 11.  $v=4$ ,  $v=-5$ . 12.  $a=\frac{1}{2}$ ,  $y=\frac{1}{2}$ . 13.  $x=8$ ,  $y=9$ . 14.  $a=8$ ,  $y=6$ . 15.  $a=10$ ,  $v=-5$ . 16.  $a=3$ ,  $y=4$ . 17.  $a=5$ ,  $y=9$ . 18.  $x=12$ ,  $y=16$ . 19.  $a=\frac{1}{2}$ ,  $v=\frac{1}{2}$ . 20.  $x=\frac{1}{2}$ ,  $y=\frac{1}{2}$ . 21.  $a=2$ ,  $y=5$ . 22.  $x=3$ ,  $y=1$ . 23.  $a=6$ ,  $v=-2$ . 24.  $a=-5\frac{1}{8}$ ,  $y=-4\frac{1}{8}$ . 25.  $x=2$ ,  $y=3$ .

**Ex Vb**—1 cow Rs. 45, buffalo Rs. 65. 2. Re. 1. 3 Rs. 3-12 as., Re 1-4 as. 4. 12 as., Rs. 2-4. 5. 10 & 12 acres. 6. 300 7 80 acres (Nunja), 60 acres (Punja) 8 12 as. & 6 as. 9 90. 10. 16+ and 80. 11 525 and 250 12. 2,400 sq ft 13.  $\frac{1}{2}$  gal and 2 gals. 14. 6 sq. ft &  $5\frac{1}{2}$  sq. ft. 15. Rs. 925 and Rs. 500 16 75 sov & 150 shillings. 17 8 and 20 m.p.h. 30 and 36 mls 18 57, Rs. 5-4. 19. Rs 200, 90 20. Rs. 120, Rs. 90. 21. (M) Rs 60 (K) Rs 48 22 A Rs. 9, B Rs. 5. 23 30 & 36. 24. 56 25. 27. 26 36. 27 12, 7 yrs. 28. 12 yrs. 29. 5 & 3. 30. 25 ft., 15 ft. 31. 28 ft., 16 ft. 32 36 ft & 2+ ft 33 H Rs 220, C. Rs. 380. 34 R Rs. 150, G Rs 100. 35 16,300, 23700 36. Rs. 3,000 at 3%, Rs. 2,000 at  $3\frac{1}{2}\%$  37. Rs 1,000, 2 and  $2\frac{1}{2}$  yrs 38 Sugar + d per lb. and coffee 3 s. + d. per lb. 39 Rs 77-8 as & Rs 32-8 as 40 13 mls & 3 m p. h 41. 45 mls. & 5 m. p. h 42 8 m.p.h. & 28 mls 43. 24 boys & Rs. 3-8 as 44. Rs. 60 & 24 men 45 1,125 46 H.=Rs. 5000 L.=Rs. 10,000. 47 H, Rs 450 C. Rs 600 48 88 lb.,  $\frac{1}{2}$  d. per lb 49 1 cwt. 50.  $\frac{1}{2}$  md., 4 as. per md. 51 5 & 3 m. p h. 52 + m p h 53. 3 and 8 m p. h. 54 3 & 7 m p h. 55 4 & 26 m p, h. 56. 3 & 27 m p. h. 57 18 & 12 m. p h

**Ex. VI.**—1 63, 95, 109, 1,331, 1728, 1234, 37,037. 2 7'29, 1'12, '512, '049, 90 61, 135 31, 13'05, 30 515. 3. 12 923, 3 606; 1'732, '707, '268, '649, 655, 1 275, 2'769, 1 111, 270 + 2+3. 4. 5. 5 0024. 6. 6241, 609,961, 5,929, 603, 729. 7. 1+2 8 3'2 9 45, +5, 45 450. No. 10. 25% 11. 32 12. Rs 2-7as. 13. 156. 14 3. 15. Rs 880. 16 37'5 in. 17 25 cm 18 20'4 cm. 19 21'2 in. 20 1 414 mls 21 10 m=1 mile. 22. Rs. 87. 23 23 ft + in 24. 23 ft. 4 in. 25 17 ft 26. 24 ft., 15 ft 27. 4+ ft., 44'7 ft. 28 5'1 ft. 29. 3'5 ft. 30. 12 ft 31 6 ft. 32. 45 ft 33.  $6\frac{3}{8}$  sec. 34 50 ft. 35 78 ft. 36 P Q 1 1'3. 37. +33 sq. in, 16 47 sq. in. 38. 3 66 cm. 39 Rs 40. 40. 3 5 ft. 41. 10. hastas. 42. Rs 18 (nearly) Rs 8-5-4. 43. 18 ft. 44 12 6 ft., 12'6 ft & 14'4 ft.

**Ex VII.—1.** (a) Rs 1,470-0-10, Rs. 270-0-10, (b) Rs. 1,417-12-6 Rs 167-12-6, (c) £ 1,572-2-1, & £ 147-2-1 (d) Rs 131-3 6, Rs. 18-11-6, (e) £ 477-15 s, £ 44-8-4 (f) £ 342-2-9, £ 42-2-9. **2.** Rs 2,395-6-5. **3** Rs. 2,706-1-3. **4.** £ 46-7-3. **5** Rs 432 **6** Rs. 1,674-13-10. **7** Rs 2,187-4-11 **8.** Rs 782-2-2 **9** In 4 yrs, Rs. 230-2-3. **12** Rs 5-9-10 **13.** Rs. 35,000. **14.** Rs 15,000. **15.** Rs. 1,250 **16.** Rs. 11,718-12-0. **17.** Rs. 2,50,000 **18.** Rs. 14,393-8-11. **19.** 91,357. **20.** 6,441 **22** Rs. 1,600, **23.** Rs. 7,000, Rs 15,625, Rs 24,414-1-0, Rs. 4,096. **24.** 5%, 3%, 5%. **25.** 3 yrs. **26.** 2 yrs. **27** Rs. 3,000-13-0. **28.** Rs 13,310. **29.** Rs. 4,53,125, Rs. 9,39,600. **30** Rs. 14,580, **31** Rs. 4,500 **32.** 4 strokes. **33.**  $A = a(1 + r/100)^n$  pt **34.** Rs 3,500, Rs 3,822. **35.** £ 2,500, £ 2,811-18 s **36** Rs. 112. **37.** Rs 39-13 10. **38** Govind. Rs. 112-6-2. **39** 5 as 2 ps. **40** 35%. **41.** 890,768, 732837 **42** Rs. 99-1-3. **43** (1) P Rs. 200, Int. Rs  $20\frac{1}{2}$ , (2) £ 842-14-0, 6%, (3) £ 247-4-0, 2 yrs **44.** £ 1,367-3-9. **45** 4%, Rs. 4,882-13 **46.** Rs. 5,000, Rs 6,077-8-6 **47.** £ 186-3-9. **48** £ 12,500 **49** Rs. 9,261 **50.** Rs 6,141-4-0.

**Ex. VIII a.—1.** 480 **2** 1,610. **3.** 5 mls. **4** 25 mls. an hour. **5** 8 **6.** 13'86 sq cm. **7.** Rs 962-8, Rs. 110 **8** Rs. 1-15-8 **9.** Rs. 320-13-4. **10.** Circle by 33 sq. ft. **11.** 24'81 ft **12** Circle, £ 50 nearly. **13** 14 in. **14.** 13 in; 109 in **15** 6,205 yds. **16** 300 grams **17.** 3 in **18.** Rs. 26, 6as 5 ps, Rs 71-2 **19.**  $74\frac{1}{2}$  sq ft. **20** Rs. 3-10-8, 2 as. 4ps. **21.** Rs 63-12-5, 25 ft nearly. **22**  $5\frac{1}{2}$  acres. **23.** 3'14 sq ft, 629 sq. ft **25.**  $\pi rc/24$  **26** £ 9. **27** 591 sq. ft. nearly 346'5 sq ft.

**Ex. VIII b.—1.** 88 sq in **2**  $75\frac{1}{4}$  sq. ft. **3.** 105 grams. **4.** Rs. 41-0-6 **5.** 14 in. **6.** 20. ft **7.** Rs. 9-7-4 Rs. 56-12-3. **8.** Rs. 51-14 as.

**Ex. VIII c.—1.** 16 sq in 2'0 sq. in., 36 sq. in 43 sq in **2.** 21 sq., in. **3**  $2,592\frac{1}{2}$  sq yds **4.**  $1,283\frac{1}{2}$  sq. cm **5** 50 ft **6** 4 ft. 8 in. **7**  $3\frac{3}{8}$  in. **8** 3'9 in. **9** 14 sq. ft, 33° nearly. **10** 44 in **11** 21 in, 14  $\frac{3}{8}$  in. **12.** 3'85 sq. in **13** 29° (nearly). **14.** 7 in,  $19\frac{1}{2}$  sq. in. **15.**  $29\frac{1}{4}$  in. **16.**  $10\frac{1}{2}$  in **17.** 2'5 min. **18.**  $15,037\frac{1}{2}$  sq. yds. **19.** 20 in,  $1,711\frac{3}{4}$  yds. **21.** (1) 16 06 sq. in., (2)  $785\frac{1}{4}$  sq. in. **22.**  $39\frac{3}{4}$  sq cm. **23.**  $21\frac{1}{4}$  sq. in. **24.** 66 sq. in. (nearly).

**Ex. IX.—1.** 216 **2.** 27. **3.** 40 **4.** 54 c. in, 16,400. **5**  $94\frac{5}{8}$ . **6** 44'1 k. g **7.** 15 in. **8.** 125. **9.** 9'53 ft **10.** 9'51 ft. **11** 11' **12** 5 ft. 9 in & 1 ft. **11** in. **13.** 2,25,000. **14.** 28. **15.** 72, 84 c. ft. **16.** Rs. 1,890 **17.** 5 mm **18.**  $\frac{3}{4}$  in. **19.** Rs 4-2-8. **20** 70lbs. **21.** 1,300, **22.** 9'4 in **23.** 1,35,000. **24.** 2,50,000. **25** 16,50,000, 289 gals **26.** 33'75 ozs. **27.** 17,901 c. in., Rs. 4-11-5., Rs 13-8-2. **28.**

22'2 lbs. **29.** 30'6 lbs. **30** Rs. 11-12-5 **31.** 6,000 cart loads **32.** (a—2d), (b—2d) & (c—2d) inches, abc—(a—2d) (b—2d) (c—2d) c in, (a—2d), (b—2d) & (c—d) inches, abc—(a—2d) (b—2d) (c—d) c in **33.** cdr (a+b+2c) / 162 Rs **34.** [abc—(a—2i) (b—2i) (c—2i)] g, [abc—(a—2i) (b—2i) (c—2i)] g+S (a—2i) (b—2i) (c—2i)2] grams **35.** bdl=12 ac **36.** 1 ft 4 in **37.** 125 in **38.** 32 ft. **39.** 104 ft. (nearly). **40.** £ 5-9s **41** 5 s 7 d (nearly) **42** 118 lbs. (nearly). **43** 93 71 57

**Ex. X—1**  $(100a+b)(100c+d)-10000$  sq m.,  $(100a+b) \times (100c+d)$  sq. cm. **2**  $(3l+m)(3b+n)$  c/16 Rs **3.**  $c=ab-d$  **4.**  $[(a+b)r-(ap+bq)]$  Rs **5**  $z(a/x-b'y)$  mls,  $\frac{1}{2}$  mls **6.**  $[(a-2)r-(b+acd/16)]$  Rs. **7**  $(ax+by+cz)-(a+b+c)$  ft. **8**  $(ap-bq)-(p-q)$  yrs **9**  $(ax+by)-(x+y)$  yrs, 20 yrs **10**  $[m(a+b)-al] - b^2$  yrs **11**  $a-b+bx/y$  yrs. **12**  $y=12x-a-p$  **13**  $[(a+c)e-(ab+cd/16)]$  Rs, Re 1-3-0 **14.**  $100(m-l)-l$ ,  $100(m-l) \times m-l(y+n)$ , 20q-2. **15.**  $(s-c) \times 100=cg$ . **16.**  $100a=l(s+a)$  **17**  $(100-r)=100y$  **18.**  $100y=[100-(a+b)]$  **19.**  $ax+by=z \times (a+b)$ . **20**  $a(1-x/100)+b(1-y/100)+c(1+z/10)+c-a-b-c(1+w/100)$  **21**  $ax+by=p(x+v)$  **22.**  $[a^2(100+c)-100b^2]-b^2$  **23.**  $a=c(a+b)$  **24.**  $a+m/h$  mls.  $p.h$ , 5 mls.  $p.h$  **25**  $[a-(my+nz)] - [x-(y+z)]$  mls  $p.h$ , 5 mls.  $p.h$  **26**  $h=2ac-(b^2-a^2)$  **27**  $ax(12m+n)-192$  Rs **28.**  $p \times (1+mc/192)=q$ . **29.**  $r=pq-(p+q)$  **30**  $ab-(b-a)$ . **31**  $p'q$  mls,  $vq/p$  hrs **32.**  $+0x^2y^2$  **33.**  $q\sqrt{4840p-5r}$ . **34**  $p/w-36d$  ft. **35.**  $lab^4c$  in **36.**  $5cd/as$  ft **37.**  $144x^2/na$  in **38**  $bpq-ac$ , **39.**  $y=2x$ . **40.**  $2c(a+b)-p$  sq. ft.,  $[2c(a+b)-p]$  d-108 s. **41.**  $(x-y)-(m-M)$ ,  $z(m-M)-d(x-y)$ ,  $\frac{1}{2}$ , 2 **42**  $xy(b-c)-2(y-v)$  days. **43.**  $(b-a)x=ah$ , 6 **44** £2,  $pqr/240$  **45**  $26880 \div mn$  sq. ft. **46.**  $11abmn^2-1204224$  **47**  $lbex-240$  hrs **48.**  $abc-290400$  hrs **49**  $a=b(f-e)$ ,  $c=d(e+l)$ ,  $e=2$  &  $f=10$  **50** £c  $(a+bd)-20$ ,  $721/32$  **51**  $a(100+d)=c(100+b)$ .

**Ex XI.—1.** 7 42, 7'43, 5 22, 124 263,000, 17'0, 174, 0640, 00702, 99 7, 60.0, 1 00, 720, 100, **2.** 1.1 051. n 4 423 iii 1'072 iv. 201'6 v 49 96 vi. '01716 **3** a 11 14 b 10'14 c 16 99 d 1813 e 88'70 f 0004427 **4** 10'839 cm **5** 1466 6 in **6** 34 49 **7** 3 330 **8.** 12 351 **9** 28'0 **10** 241, 165 **11** 8 min 19 sec **12** 12'4 **13.** 17 0%, 21'2% **14** 5 4, 11, 8'5, 8'7, 1 9 & 11 2%, 6 5% **15.** 7 27, 9 90, 4'41, 6'34 & 5'03%, **16,** 70 37, 21 22, 99, '75, 11, '03, '03%. **17.** a. 47 0, 32 7, 29 9, 5 6, 11'2 & 49 5, 31 4% b 6'8 1'2, 65 5, 4'2, 1'4 & 21'0%

**Ex. XII a.**—1. 3 in. 2. 48 in 3. 17 in. 4. 447 in 5. 145 in. or 9 in 6 16 in., 33 in., 7 in. 7. 845 ft., 13½ ft 9 in or 16 in., 32 in. or 46 in 9 13 cm. 696 cm. 10. 175 cm., 68 cm 11. 26 in., 245 in. 12 15025 ft. 13. 106 ft. 14. 13½. ft 15. 259 units.

**Ex. XII b**—1. (i) 9½ sq. in., 91¾ sq in. (ii) 58 sq in., 1953 sq. in. (iii) 13 sq. in., 54 sq. in. 2. (a.) 93 sq. in., 1955 sq in (b) 168 sq in (c.) 825 sq in 3 325 sq. dandas. 4. 322 sq units 5. 462 sq. dandas 6. 381 sq dandas.

**Ex XIII.**—1. (a) 69 c. ft., 275 sq. ft. (b.) 25 c. ft 525 sq. ft. (c.) 416 c. ft., 688 sq ft. 2. 98 sq. in 3 5 ft., 876 lbs 4 8 min. 53 sec 5. 42, 240 c. yds. 6. 34 tons.

**Ex. XIV.**—1. 246 c ft. 2. 3326 gms 3. 14 gm. 4. 19,250 gals 5 Rs 18,150. 6. 673. 7. 289 c. cm. 173. 8. Rs 2,387 9 38 in 10. 51 in. 11. 587 in 12. 578 in. 13 1,799 ft 14. 284 in 15. 168 ft. 16. 352 sq. ft., 4526 sq. ft. 17 13½ in 18 Rs. 3-7-0 19. 1485. 20 4321 21 226 sq ft. 22 Rs 41. 23. 7040 gms 175. 24 8 in., 32 in. 25. Rs 62-13-9, 10,560 lbs. 26. Rs. 27-13-3. 27. Rs. 41 28. 75 lbs (nearly) 29. 4 cm 30 Rs 209 31. 2500 metres 32 7 ft. 10 in. 33. cy cu 13. 14 34. Rs. 165. 35. 1 in 36. 29 in., 116 in 37 14 ft., 115 tons 38. 115 ft. 39 663 lbs 40. 1980 lbs 41 1 in. 42 672 ft 43. Rs. 275-5 as., Rs. 110 44. 100½ c. ft. 45. 7 min 52½ sec. 46. 1½ m. p h. 47. 7 ft p. sec. 48. 5 in. 49 845 sq ft. 50 Rs. 361-7 as 51. 04 in. 52. 302 ft. 53 124 in 54 1 ft. 55 40 tons, (nearly). 56. 243 in. 57. Yes No 58 1588 in 59 15174 c ft 60 Rs. 70. 61 00455 in.; 38 in 62. 35 ft., 70 ft. 63. 504 hrs.

**Ex. XV.**—1. 1154 c. in. 2. 444 in. 3. Rs. 233 4 3 ft 9 in. 5. 651 lbs 6 (1) 816 sq ft. (2) 2,112 c. ft. 7 196 sq in

**Ex. XVI.**—1. 34496 c cm 2. 30 in. 3 12,936 c in, 2,310 sq in. 4. 306 sq. ft 5 770 c. in., 726 grams. 6. 372 yds. 7. 70 c ft 1008 c. in. 8. 550 sq. in. 9. Rs. 88 10 19½ c. ft. 11. 154 sq ft 12. 12 ft. 13. 192 in. 14. 3½ in. 15. 039 c. in. 16 11319 gms. 17. 1,320 sq ft. 18. 48 in. 19. Rs. 2,380. 20. 816 c. in 21 1 ton 142 cwt. 22 8624 c. in., 12936 sq. in. 23 48 c. in., 173 oz. 24 12 min. 25 938½ c. in., 7 min 47 sec. 15 as. 26 4492 c. in. 27. 347 in. 28. 121 sq in., 67 c. in. nearly. 29. 2,131 sq. ft.; 12,0214 c. ft. 30. A cone, 66 in.; 171 sq. in., 376 c. in. 31. A cone, 52 in.; 684 sq. in.; 1186 c. in.

**Ex. XVII.**—1. A Rs 22, B Rs. 33. 2. A Rs. 20, B Rs. 18; C Rs. 16 3. A Rs. 63, B Rs. 28. 4. Rs. 2,550. 5. 9 mths. after A com-

menced business. **6** Rs 43-12-6. **7.** Rs. 35, Rs. 140, Rs 315 **8.** A Rs. 517-8, B Rs 828, C Rs. 1,012—8. **9.** Rs 52. **10.** Rs. 560, Rs. 540. **11** 40%, Rs. 1,440. **12** Rs. 150, Rs. 93-5-4. **13.** Rs. 270. **14.** A Rs. 160, B Rs 284.

**Ex. XVIII.**—**1** £ 69-9-9. **2.** Rs 8-9-8 **3.** 11 as 2 ps **4** £ 482-2-6. **5** 1,200 lbs. **6.** 6 as. 7 ps. **7** Rs. 250. **8.** 3s. 9d. **9** 1-11 5 22. **10.** Rs 600. **11.** 14+. **12.** 11% nearly. **13.** 8% Rs. 6-4 as. **14.** 20 8%. **15.** Rs. 35-2 6. **16.** 61'6". **17** 2 measures (nearly) **18** 38½% **19** Rs. 23-12-4 gain. **20** Rs. 60-15-6. **21** 11%. **22** Rs. 5, 44 4%. **23.** Rs. 7-6-11, Rs +15-3 **24.** 6 viss.

**Ex. XIX.**—**1.** 2 days. **2.** 13¼. **3.** 2½ **4.** 7 2 days. **5.** 24 **6.** Rs 9-6 as. **7.** 30 days. **8.** 40 min. **9** 3¼ min **10** 10 min. **11.** 2 hrs **12.** 14 hrs **13.** 6½ days, **14** 40 boys **15.** 36 and 24 days. **16.** 15. **17** ½. **18.** 5 days **19.** A in 12 hrs, B in 12 hrs, and C in 6 hrs. **20** A Rs. 4-11, B Rs. 3-12, Boy 15as. **21.** 36 **22.** 29½ weeks. **23** 11 weeks and Rs. 4,851 **24.** 37. **25.** After 5 min. **26.** A in 9 min. and C in 8 min. **27.** ¾, 12 min. **28** 15 min, 12 min. **29** 60 min. **30.** 160 min.

**Ex XX**—**1**  $h = m - (a - b)$ ,  $n = am - (a - b)$ ,  $h = 3$ ,  $n = 18$  **2.**  $2qd - (q^2 - m^2)$ , 7 **3.**  $(q - p + 10ar) - 20r$  104. **4.**  $(b - c) - (b - a)$ . ¾. **5.**  $(16t - mr) - 16(d - m)$  **6**  $m(100 - d) = c(100 + g)$  **7**  $\frac{1}{2}(100 + a) \times (100 + b) - 1,0000$ . **8.**  $\frac{1}{2} = 1000000d - (100 + a)(100 + b) \times (100 + c)$  **9.**  $10000 \times (1 - v) = \frac{1}{2}(100 + p)(100 - q)$  **10.**  $abc - (ab + bc + ca)$  days. **11.** i.  $ab - (b - a)$  hrs, ii.  $abc - (ac + ab - bc)$  hrs **12.** **12**  $(3b - a) - 2$ . **10.** **13**  $B = a(p - 1) - (p - q)$ ,  $A = aq(p - 1) - (p - q)$ , 80 **14.**  $y = 1 + a + b$ , 27 **15**  $pr - (p + q)$ . **16.**  $acq - pb$  days. **17**  $a(100 + g) - (100 - d)$ . **18**  $pgv(1 + w - 2p) - 96$  **19.**  $\frac{1}{2} \times (a + b) - x^2$  sq. cm, 26 **20.**  $\frac{1}{2}(a + b) - 320(1 + y)$  **21** Rs.  $px - (ax + by)$ . Rs.  $pb - (ax + by)$  **22**  $x = 12ap - [12a + b(12 - m)]$ ,  $y = pb(12 - m) - [12a + b(12 - m)]$  **23**  $v = (3c + 2b - a) - 3$ , 110 **24.**  $2a = b - a$ ,  $a = 23$ ,  $b = 43$ . **25**  $288v(1 + b + 2v + t) - ad$  **26**  $a^2 + b^2 = c^2$

**Ex. XXIII.**—**1** 25 24 **2.**  $x - (x + y)$   $y - (x + y)$ ,  $(1 - v) - (1 + v)$  **3.**  $ax - (a + b + c)$ ,  $bx - (a + b + c)$ ,  $cx - (a + b + c)$  **4** 8 1. **5.**  $a(c + d)$   $bc - bd$  8 5 1. **6.**  $(25x + 28y)(10x + 7y)$  **7.**  $b(a - b)$ , 3 1. **8.**  $(cl + cm + mg) - f$  as., 16 as. **9.** 24 ft. & 16 ft. **10.**  $14m + 11n = b \times (m + n)$ . **11.** 80 & 180 grms. **12.** (i) 2 9, (ii) 2 3. **13.** 3 4.

**Ex. XXIV.** **1** Rs. 93-8-3, Rs. 5-3-0; Rs. 20-12-6 **2**  $T = 1'21''$  **3.** 3% nearly. **4** 5129 gms., £1-12-1 **5** 60 ft., 4'5 in., 141'43. ft. **6.** 3,200 acres, Rs. 4 **7.** Rs 9,315, Rs. 5,400. **8.** 364,571 tons. **9.** Rs 13,396. **10.** 500,400. **11.** 80 men **12** 72 men, 288 women. **13.** £2,686-13-4 **14** 52 days. **15.** 938 hrs. 19 min. 59 sec. **16.** 10 ft.,

Rs. 296 17. 402 ft 18. 33 & 39 mls. a day, 286th mile 19  
 Rs. 16, (Read 7 & 8 & 5 6 for 8 7 & 6 5) 10 500 250 21. 10 mls.  
 p. h. 22. 1'6 c. in 23. 172 8 acres. 24 1,369 sq. yds 53. 25  
 562 5. 26. 13 326 sq in 27 82. 28. Pressure of 1 lbs per sq ft. =  
 pressure of 489 1 grm. per sq. cm 29. Rs 80-15-4 30 20 ft.

**S.S.L.C. (1913)** 1. (a) (1.) 919, 366, (2) 266, 527, 674, 61571  
 40073 31321 (b) 3'24. 2. (1) £ 49—3 (2) Rs. 336—11—5 3. 3035  
 ft. 4.  $v + v - 3$  5 1 36 furlongs where 1 is the no. of revolutions of  
 the pedal, 13 fur. 195 yds, 1ft. 8 in. 6. II 1 + 2 1,  $H^1 - H^2 + 4$  1.  
 7 2 in. 8. 90°, 53°, & 37°, 7 07 sq in. 10. Rs 306—4. 11 Rs 2-10-7  
 12. 3103'788 kg. 13. 6'9% (1914) 1. +35 1%; —7% +355'5%,  
 +38'7%, +17'3%, 698,667, 683,348, —2'2% 3 (m—n)—(m—n).  
 10 nearly 4 W M 5 16, 5. 100(10r—(100+p)(100+q), Rs. 400  
 6. 26'5 ft. 7. 504 sq. yds 8. 285 sq in 9. 3 mm, 10. 585+26  
 (1915) 1, (i) 7s. 6d (ii) 8s. 1d. (iii.) +2%. 2 18s. 3d. 3. 3 lbs nearly  
 4. T [3g + w + 2p + 4v] - 4, 320, 5.  $a = b(f - t)$ ;  $c = ab(f - t)$ ,  $e = 2$ ,  
 f 10. 8. 51 tons nearly. 9. Rs. 5—10, Rs. 3—12. 10. Rs 23,283  
 12. 88 lbs (1916). 1. (i) —12%, —17%, (2) +11% +14%. (3) —67%  
 —75%, (4) —26%, —27%, (5) +2% +1'5%. 2. Rs 9—4—6 4 8 5 17%  
 4as 7. 1'64 in 9  $\frac{1}{2} (p+q+r) (4d+a) - (ap+bg+cr)$  as,  $d = 20$   
 10.  $v = 6\frac{1}{2}$ ,  $v - \frac{1}{4}$  12 H E. .9-8 (1917). 1. 77 2 Rs 61,100,  
 Rs. 52,975-108, 13'3% 3. Rs. 525, 4. Rs. 4,472—14, 6 4' 5. 205 ft.  
 nearly. 8.  $x = a - 7/2$  where x is the no. thought of and a the answer.  
 9. Rs. 70, Rs. 130 10. 5 cm. (1918) 1. Rs. 3—13—3, 16 7%.  
 2. Gain = Rs 200. 3. 13—37, 12—37, 16—45, I & II at the 29th mile  
 at 13—8, I & III at the 66th mile at 14—52 4. 1800,000 sq. mls,  
 1 in. = 120 mls. 5. 4%, 4'8%, 5'8%. 6. Rs. 1232. 7. 19 3 sq cm.  
 8.  $(m+ny) - (x+y)$ , 36 + 9. 29 miles. 10. (2)  $\frac{1}{2}$ . 11. 30 miles.  
 12. 17 in. (1919) 1. 38'6, C (highest) 41'4, D (lowest) 34'5 2.  
 Rs. 1600, 32'5%. 3. 127 acres. 4. (i) A reaches Q at 2-30 p.m., B at  
 1-5 p.m., (ii.) At the 37½ mls from P at 11-15 a.m., (iii) 12½ mls. 5.  
 Rs. 112. 6. 25 8 sq. in. 7. 2 ft. 8 in 8. 24 men and 20 boys 9. (i) 7'2  
 in, (ii) 18 men 10. Cone. 14 in 11.  $(am+bn) (100+c) - 100 (m+n)$ ,  
 Re. 1—9. 12. 2,964'5 sq. ft. (1919 Re. Ex.) 1. A 57, B, 37, A 1st, B 67th.  
 2. 16 lbs. 3. 13 yds. 4 171'5 cub. in., 128. 5. To get books from  
 London by Rs. 42—8—0. 6. 3os., 15s; 10s. 8. Rs 583-5-4. 10. Gain 20%.  
 11. 881½ yds. 12. (i) 60/m—60 n (ii.) 3 mn—(n-m) min. (iii.) 202 mm.  
 (1920.) 1. (i) 66'9% (ii) Rs. 1,265,368. 2. 11,610 cub. yds., 7½ mm.  
 3. 175 ft. 4. Rs. 115—8. 5. Rs. 240 & Rs. 360 9.  $mnp^2q$ . 37½  
 (37 men and 1 boy) 10. 3 in. 11. 3000 c. cm. 12. 6'8%, £2,516—16.

(1921.) 1. 6,076 ft 2. Of the 3 measurements at least *one* should be that of a side,  $a=2'1$  in.,  $b=1'5$  in.,  $c=1'9$  in.,  $A=79^\circ$ ,  $B=41^\circ$ , &  $C=60^\circ$  3.  $14'96$  sq in. 4. (i) 3 9%. (ii) 7 7% (iii) 8 as 5. Rs 45—4—10. 6 75%. 7  $34'7$  8  $14\frac{1}{2}$  days 9. 12,667 sq ft. 10 Rs.  $a(r+1)-rs$ . Re 1. 11. B.A I 8 13 294 (1922.) 1. (1) Rs. 17,040, Rs. 24,538. (2)  $7'1\%$  2. 250 yds nearly. 3.  $1'6$  in.,  $3'9$  in.;  $7'1$  cm.,  $11'4$  cm. 4. 24. 5 Rs. 95,575. 6.  $22'8$  in.,  $14'3$  in. 7. 91 oz 8.  $40\%$  9. Rs. 72,766. 10.  $34'40$  tons 11. Asia  $122^\circ$ , Europe  $27^\circ$ , Africa  $82^\circ$ , Australia  $22^\circ$ , North America  $58^\circ$ , South America  $49^\circ$ . 12  $CD=2'4$  ab,  $3'9$  in (1923.) 1 8047462, 8189960, (2)  $3'6$ . (3)  $52'5$  2. (1) 15,574 gms. (2) 4 52, 35 & 32. 3.  $17'8\%$ . 4. 4 a. 3 p 5 Rs. 192. 6. 26. 8.  $(v^2-u^2)-v$  m. p h.,  $59'6$  m.p.h. 9 13ft. 4 in. 10.  $46'6$ ,  $41'6$  ft. 11. (a) 1. 4 (b)  $5b^2 \div 4$ , 25,000 12  $21'3$  in.,  $18'10'3$  c in., 655 sq in (1924) 1. 1798, 2047, 2324, 1901 1722, 1901, 10379, 667, 647, 11693. (5) 7 3%, 5 6%, 3'3%, 5 7%. 2. (1) 62 lbs. 6'8 ozs. (2) Rs. 7—5 as. 3 (a) Rs 2000 (b) Wine 13 gals. Water 19 gals 4. Rs.  $41-8-0$ , Rs.  $3-7-4$ . 5  $54'6\%$  6 98. 8 23yds. 10  $a=3$ ,  $b=8$ ,  $2\frac{1}{2}$  lbs 11. 7920000. 12. 12 c. ft.  $1440$  c. in.  $44$  sq ft,  $10'6$  c. ft.,  $17\%$ . (1925) 1. 2'7, 2'2,  $1'4$  and  $9\%$ . 2 Rs 15—12. Rs. 28—14, Rs. 20—4 3 £28—16 s. 4. 40 yds. 5. Rs. 958—13 as. 6 5 miles 1232 yds. 7 £24—13—4 8. 40 cm. 9  $53^\circ$ . 10 2 ft.,  $30^\circ$  11 £135, £30. 12. 4'9 acres. 13.  $2'5$  gals., 9a. 11p (1926-A) 1 (a) 6506'79 lakhs. (b.)  $1'9\%$ — $12'1\%$ ,  $+223'8\%$ . 2 18 miles per hour. 3. 999'90 ozs. 4. (a.) Rs. 5—4. (b.) 160 lbs. (c.) 40 lbs. 5 650 links,  $90^\circ$ ,  $1'76$  acres 6.  $745'7$  cub. cm. (B) 1. A £1050, B £872—10s balance £52—10s. 2. Rs. 6-1-2 3. £150, £100, £200. 4.  $6\frac{2}{3}$  min 5. A 3420, B 2880 (first election) A 3780, B 2970 (second election). 6. £1778—19s. (1927-A) 1.  $7'9\%$  2  $33'1\%$ ,  $\frac{ax-by}{a-b}=z$ . 3. Rs 1,000. 4. Active members 140 and Associate members 60. 5. B will overtake A at 8 a.m. at the 12th mile. (B) 7. A gets Rs 1-6, B Rs 1-10. 8. 1 2. 9. 4 hrs. 37 min. 12 sec. 10. 60 miles and 90 miles respectively 11. 3762 yds., Rs. 1881. 12. 24 ft., 18ft. (1928-A) 1. 125 2  $3a+4c-10=e(b+d)$ , 3. 3. Rs. 1,500. 4 68 miles. 5.  $5'8$  sq in 6. Rs 250 7 Rs. 242. 8. 318 9. 16 ft. 10 10-30 a.m., 6-30 a.m. (1929.) 1-(a) 51 yds (b) 2,160 marks. 2. (a) 280,320, (b) Rs.  $\frac{2}{3}p(r+y)-m-ny$ , Rs. 9. 3. 50 men. 4. Rs. 4,600. 5.  $6'24$  sq. in 6.  $5\%$ , Rs. 250. 7. Rs. 334-11c. 8. Loss  $1\%$ . 9. Rs 110 10. 21 ft. 11. 7-36 P.M., 3 and 5 P.M., 19 miles from Q. 12. 352 ft.

## OPINIONS.

These are pre-eminently days of helps to students affording them all possible facilities for passing Public Examinations. Mr. P. S. GANESA SASTRIAR's recent publication is a timely help to the S. S. L. C. students. Elementary Mathematics is a compulsory subject for all candidates for the S. S. L. C. Examination. Copious collection of sums under all the important heads of the subject will materially enable even ordinary students by dint of industry mainly to get through the examination successfully. Every student is advised to furnish himself with a copy of the book and honestly try to work every sum.

Trichinopoly. }  
17th, June, 1920, }

G SESHAIYANGAR,  
*Headmaster, National High School,*  
*Trichinopoly*

One of the means by which a student of Mathematics can secure skill in working out problems in Mathematics is to do plenty of exercises in the subject and most of the books on Mathematics in the field do not furnish large number of examples dealing with one principle at a time. Dull students very often find it extremely hard to solve exercises given in a book simply because each of them involves some change of principle or introduces an element of complexity unknown to them. Hence the teacher is driven to the necessity of manufacturing his own examples for his class use but it is not many that can have time and patience to do it.

The book under review supplies a long felt need during the S. S. L. C. course of a boy and Mr. P. S. GANESA SASTRIGAL has taken immense pains to arrange the examples in a rational manner and has shown himself a practical teacher of Mathematics by presenting problems of both intensive and extensive nature.

The book will be eminently useful as a Class Book for teachers of Mathematics in the IV, V and VI Forms and for such boys both in class room and in their homes.

S. P. G. High School,  
Trichinopoly,  
18th June, 1920.

S K. DEVASIKHAMANI,  
*Head Master.*

